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### ON THE MINUTE MEASUREMENTS OF MODERN SCIENCE

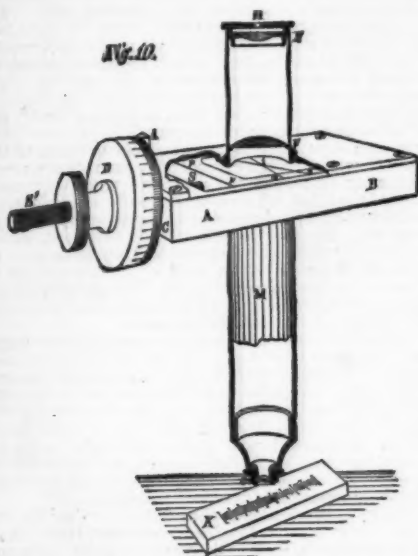
By ALFRED M. MAYER

Article V.

On the Reading-Microscope, or Micrometer-Microscope.

THE reading-microscope is so called because the instrument was originally devised to read on graduated circles those minute arcs which are invisible to the naked eye. It was, however, soon applied to the measurements of minute lengths, and is now extensively used for that purpose.

In the applications of the micrometer-screw as a measuring instrument, heretofore described, the minute fractions of its pitch were determined by various mechanical appliances attached to the screw; such as the contact-lever, the contact-level, etc. In the instrument now to be described these minute motions of the screw are seen and measured by the



THE MICROMETER-MICROSCOPE.

aid of a microscope. The best way to give a clear understanding of any instrument is at once to place it, or a drawing of it, before the person to whom we wish to describe it; therefore, without further introductory talk, we will request the reader to look at Fig. 10, which is a perspective drawing of the essential parts of the instrument. The support for the microscope is not shown, because I do not wish to confuse the reader with unnecessary details.

In Fig. 10, M is the tube of the microscope shown in section, so as to exhibit its interior; at O is a lens called the objective, because it is just above the object which we wish to examine. This objective forms at *i* a magnified image of the object placed under it. This magnified image is looked at through the two lenses E and F; and as these lenses form a simple microscope, or magnifying glass, they magnify yet more the image of the scale at *i*. It is now readily understood how two lines on the scale K, which may really be only the  $\frac{1}{1000}$ th of an inch apart, may appear as though one or two inches apart when viewed through the microscope. At *i*, that is exactly in the plane in which the lens *e* forms the image of the scale, are stretched two fine spider threads, taken from the egg-cocoon of that insect. The ends of these stretched threads are shown at *a* and *b*. These threads cross each other at *i*, at an angle of about 30°. They are stretched on the top of a rectangular frame, *p, p*, of brass which slides in guides cut in the box A, B. This frame *p, p*, carrying the cross-threads, is moved backwards and forwards by means of a screw shown at *s* and *S*. A helical spring is placed around the screw at *s* and constantly presses between the frame *p, p*, and the end *e* of the brass box A, B. The nut D of the screw is thus always pressed firmly against the right hand sides of the threads of the screw, and loss-motion is avoided in the screw when the nut D is rotated.

The action of the instrument is now readily understood. Looking into the microscope through the hole H, one sees a highly magnified image of the divisions of the scale K, and also observes, stretched across these divisions, two straight, fine black lines intersecting at *i*, at an angle of 30°. For simplicity of illustration, we will suppose that the distance between the lines in the scale at K is  $\frac{1}{1000}$ th of an inch, and that the same lines in their magnified image at *i* are one inch apart. Now suppose that the screw, which moves the plate *p, p*, on which are stretched the spider threads, has 100 threads to the inch. In this case one revolution of the nut D will move the spider threads  $\frac{1}{100}$ th of an inch over the image of the scale. The distance, however, is only  $\frac{1}{100}$ th of that separating the lines in the magnified image of the scale; hence, one hundred revolutions of the nut D will be required to cause the cross threads to move over one division of the scale, or, the  $\frac{1}{1000}$ th of an inch. Hence, as 100 revolutions of the nut D equals a motion of only  $\frac{1}{1000}$ th of an inch on the image of an object placed at K, it follows that one revolution of the nut will move the thread over only  $\frac{1}{1000}$ th of  $\frac{1}{100}$ th of an inch, or the  $\frac{1}{100000}$ th of an inch of the object. But the nut, or drum, D,

is divided into 100 parts; hence, a rotation of the drum through one of these parts will move the point of intersection of the cross-threads, over a portion of an object placed under, equal to only the  $\frac{1}{1000}$ th of  $\frac{1}{1000}$ th of an inch, or, to the  $\frac{1}{100000}$ th of an inch.

Here I wish the reader to clearly understand that I do not say that we can really measure down to such a minute magnitude with the reading-microscope; for the  $\frac{1}{100000}$ th of an inch is far too small a magnitude to be seen even when the eye is aided by the most powerful optical instruments; and here I may ask my reader if he thinks that he can directly measure with any instrument a smaller quantity than he can make visible in that instrument?

While explaining the action of the micrometer-microscope, I find that I have, at the same time, given the reader an idea of the method of obtaining the actual linear value of the readings of the drum, or nut, of this instrument; for if, for example, we count the number of revolutions of the drum D required to move the cross-threads over the magnified image of, say, the  $\frac{1}{100}$ th of an inch, or a millimeter, and then divide the  $\frac{1}{100}$ th of an inch by this number of revolutions, we will have the linear value of one revolution of the drum. This value of a revolution of the drum has to be very accurately determined before we can use the instrument. For this purpose, we progress the threads over many separate divisions on an accurately cut scale, or over the divisions on a scale whose errors have been accurately determined by comparing them with similar divisions on a government standard.

To give an example of the determination of the value of one revolution of the drum of a micrometer-microscope, and to furnish, at the same time, information as to the degree of precision attained with this instrument, we will here present an example of such a determination taken from my laboratory note-book.

I placed under the reading-microscope a scale divided into millimeters and tenths of millimeters by Brünner, of Paris. This scale is formed of fine lines cut on a plate of platinum, and it was found that its first millimeter was exactly of the same length as the standard millimeter at the office of Weights and Measures in Paris. I focused the microscope so that the divisions of the scale were very sharply defined. The scale was then adjusted so that a line drawn at right angles to the lines of the scale was always bisected while the screw moved the point of intersection of the cross-threads over the image of this line. When this adjustment had been perfected, I knew that the motion of the point of intersection of the threads was over the line on which alone can be measured the real value of the divisions of the scale. The point of intersection of the threads was now brought to bisect a line on the scale, and the reading on the drum D, at the index point I, was noted. Then the cross-threads were moved till they had traversed the millimeter and bisected the line which marked its boundary. This operation was repeated with different portions of the screw, and the results tabulated, so that we can at once tell the exact pitch of the part of the screw used. It should here be observed that the operator must always turn the drum, D, in the same direction when making a measure, and thus move the cross-threads to bisection with the same direction of motion. This is important to notice, for although the nut, from the action of the spring in the instrument, cannot have a real "back-lash," as that defect is generally understood, yet when the screw, which has been moved in one direction, has its motion reversed, the compressions in the apparatus are momentarily relieved, and this causes an error in the measures.

The following are a few determinations made as described above:

No. of Observation.	Revolutions equal to 1 mm.	Differences from the Mean.
1)	10-690	+005
2)	10-685	-000
3)	10-680	-005
4)	10-685	-000
5)	10-680	-005
6)	10-690	+005
Mean.....	10-685	

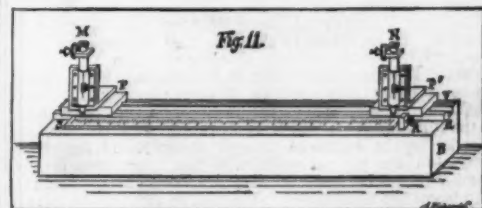
If we divide one millimeter by the mean number (10-685) of revolutions and fractions, we obtain .0009358 of a millimeter for the distance the cross-threads progresses over an object, under the microscope, when the drum D is rotated one revolution. Looking at the table of differences, the reader will observe that the departure from the mean—which we take

as the true result—is only .005 or  $\frac{1}{200}$ th of a revolution of the drum. Since one revolution of the drum equals .0009358 of a millimeter, the error made in our bisections is only the  $\frac{1}{200}$ th of .0009358 millimeter, or  $\frac{1}{40000}$ th, say  $\frac{1}{10000}$ th of a millimeter. As a millimeter is nearly  $\frac{1}{25}$ th of an inch, the error, given in inch measure, is  $\frac{1}{10000}$ th of  $\frac{1}{25}$ th of an inch, or  $\frac{1}{250000}$ th of an inch. Evidently the mean of the measures is closer to the true length than the above error; and the mean of a longer series of measurements certainly brings us to  $\frac{1}{250000}$ th of an inch of the true measure.

It would be useless to attempt to give an extended account of the various applications of the reading-microscope, I therefore have selected as examples of its use two operations of a highly useful and practical character. The first is the determination of the error of a measure whose length is marked by two lines drawn on a bar at right angles to its length. This sort of measure is technically called a *measure-à-trait* or *line-measure*. The scale generally used by draftsmen is an example of this kind of measure. The second operation to be described is the determination of the error of a measure known as a *measure-à-bouts* or *end-measure*, so-called because the length of the measure is the distance between the centers of the plane faces at the ends of the bar. An ordinary yard-stick, or one of Brown & Sharpe's scales, is an example of this species of measure.

#### 1. The Determination of the Error of a Line-measure.

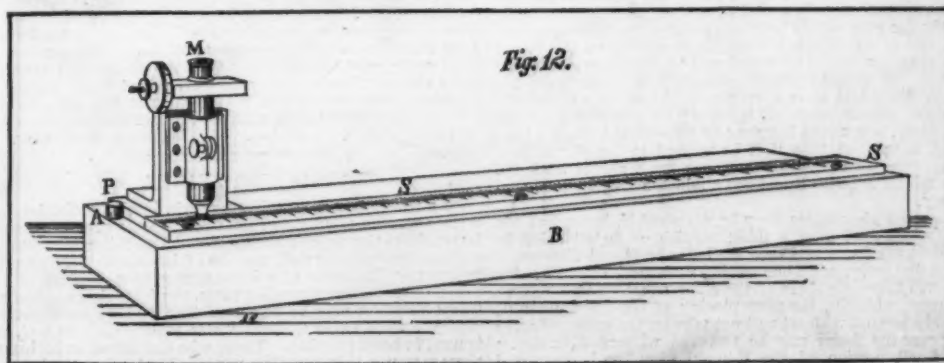
In Fig. 11 is shown the arrangement of apparatus for measuring the error of a line-measure. On a metal bed, B, is cut a straight V guide, V, and also a ridge, R, with a plane surface. On this V and ridge slide two plates, P and P', carrying the reading-microscopes, M and N. The linear values of a revolution of the drums of these microscopes are accurately known. With this apparatus a comparison of a measure with a standard is made as follows: The standard yard or meter is placed on the bed of the apparatus with one



COMPARISON OF TWO LINE-MEASURES.

of its ends against the abutting screw, A. A line drawn on the measure at right angles to its lines of division is brought parallel to the V guide. This is accomplished by placing the standard on the bed, so that when one of the microscopes is slid along the V, its cross threads constantly bisect the line drawn in the scale. The microscopes are now moved over the lines which terminate the standard measure, so that the cross-threads of one microscope bisect one of these lines, and the cross-threads of the other microscope bisect the other line on the standard. The standard is now removed, and the measure whose error we wish to determine is put in its place. One of its terminal lines is brought under the cross-threads of the microscope, N, by rotating the abutting screw, A. If this measure is of the same length as the standard, the cross-threads of the microscope, M, will now bisect the other terminal line on the measure. If it does not, then the measure is either shorter or longer than the standard, and the amount by which it is shorter or longer is given by the amount of rotation of the drum of microscope, M, required to cause its cross-threads to bisect the terminal line of the measure.

During this comparison it is of course necessary that the temperature of the apparatus and of the measures shall be the same, and that this temperature shall remain constant during the successive measures. The comparison, as above made, gives us the difference of the measures only at the temperature of the bar during the measures. If the measures have to be compared when they are at the temperature of melting ice, we are obliged to use an apparatus specially constructed for that purpose, which I shall describe in another article; or, if we know the co-efficients of expansion of the metals composing the bars, we may reduce our comparison



DETERMINATION OF THE ERROR OF AN END-MEASURE.

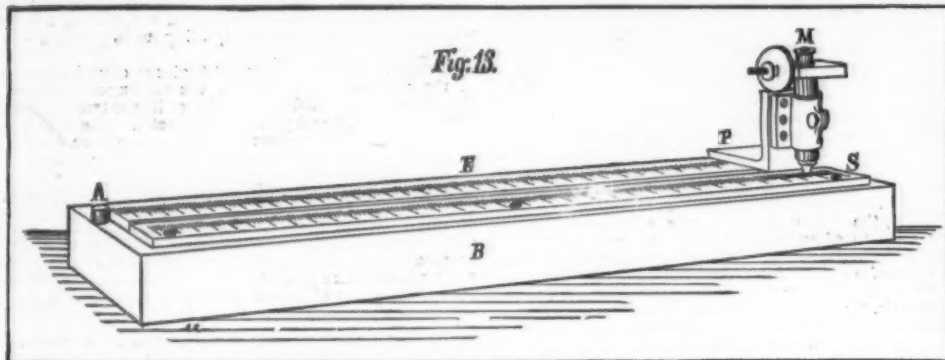
to what it would be if both bars had the temperature of melting ice.

## 2. The Determination of the Error of an End-measure.

In our description of the contact level applied to a micrometer screw, in Article III, we explained how two end measures could be very readily compared with the instrument then described. In the present problem, however, we have to compare an end measure with a line measure. Various methods more or less complex have been devised for this purpose. The one here described is sufficiently accurate for all purposes of the engineer, and has been used by the writer for several years. Figs. 12 and 13 show the apparatus, and serve to illustrate the method of making the comparisons. On a bed, B, of Figs. 12 and 13 rests a standard line measure, S. This measure is screwed at one of its ends to the bed-plate, the other screws only hold it down on the bed-plate, and at the same time allow the measure to expand or contract with the rise or fall of temperature. Over this standard is a reading-microscope, M, attached to an L-shaped metal plate. The front and lower edge of this plate slides along the side of the standard while the microscope, M, is focused on its divisions. A rounded steel button on the end, P, of the L-shaped plate abuts against a strong steel cylinder, A, or against the rounded face of an abutting screw. When the microscope is in this position, its drum is rotated until

being shown. It is, therefore, evident that not only does water repel fatty colors, but a thin fluid repels a thick fluid; and this even takes place when they are one and the same substance, but of different fluidity and concentration.

I took a very thick solution of gum arabic, to which I added glycerin and color, and treated a lithdruck plate with the mixture. I found that this color was taken on in the same way as the fatty varnish color. The first picture, indeed, was not good, nor the second, nor the third, since the thickness, or the consistency, of the color must correspond exactly with the dryness of the gelatine film. This proportion, however, soon adjusts itself. Should the color be too thick and the gelatine film too wet, the picture will take on almost no color, but the color will draw to itself some of the moisture from the film. With the first impression a little water remains in the paper, but the film is drier, and, on being rolled a second time, already takes on more color, and so on until the lithdruck plate attains exactly the required degree of moisture. Thereafter this proportion remains constant, and the operation may be continued regularly. The gummy water-color gives off each time to the film as much moisture as the latter can absorb, thus feeding it continually with moisture, so that damping the film with water and then drying it between the pulling of each impression is rendered quite superfluous. This process is, therefore, especially suited for Schnell-press printing.



DETERMINATION OF THE ERROR OF AN END-MEASURE.

the cross-threads bisect one of the lines of division on the scale. This particular line is noted as well as the reading on the drum. The line which the cross-threads bisect on the scale is detected by sliding along the scale the point of a fine needle, and when this comes on the line we have bisected, the needle point, of course, will be seen in the microscope under the cross-threads.

The plate P is now slid along the edge of the standard to its other end, as shown in Fig. 13. The end measure E is placed with its end against the abutting cylinder, A, and then the plate, P, of the microscope, M, is brought to abut against the other end of the measure, as shown in Fig. 13. Evidently the cross-threads of the microscope now cut a point on the standard scale which is distant from their previous bisection by the length of the end measure. If the cross-threads in the present position of the microscope do not bisect a line on the standard, they are moved by the drum so as to bisect the nearest line in the field of view of the microscope; and the amount and direction of the revolution of the drum required to bring the cross-threads to bisect this line gives the amount by which the end measure is shorter or longer than the standard line measure.

In the above operations we have assumed something which we have no right to assume; that is, that the ends of the end measure are truly plane and that they are at right angles to the central line of the measure. To correct any error arising from want of truth in these planes, we turn the bar with its face down on the bed-plate, and make a measure of its length in this position. Then we reverse the bar, end for end, and take two more measures, one with the face of the bar up, the other with its face down. The mean of these four measures is taken as the length of the end measure.

## MECHANICAL PRINTING IN WATER COLORS.

ABOUT six years ago I wished to ascertain exactly the power possessed by an exposed chromated gelatine negative of partially taking on fatty ink, and I found that the usually accepted explanation was insufficient. The usual explanation is that the water repels the fatty color; therefore, where the gelatine is much swollen—that is, has taken in much water—little or no color adheres; but where the gelatine can swell little—that is, is drier—there it takes on the color more freely. This explanation is correct so far as it goes, but it is not exhaustive. Certainly the degree of wetness or dryness of the different parts of the gelatine is the principal cause of the greater or smaller quantity of fatty ink taken on. It is, however, not water alone that repels the fatty ink, but every very fluid substance possessing no adhesiveness; even oil repels a fast color if it be also fatty, and if the latter be adhesive on being rolled it is drawn out into threads.

In order to make the thing clearer I shall give a simple example: If one were to dip a finger into a thick solution of gum arabic and then place it upon a dry body, such as glass, paper, or even the other fingers, the sticky finger would adhere to the substance in question, and on removing the finger forcibly the gum would be found to have separated into two parts, one of which would continue to adhere to the finger while the other would be transferred to the other substance or body. It would be quite otherwise, however, were the gummy finger laid upon a wet place. Then the gum would no longer adhere, none of it would be transferred to the other body, nor would it leave any trace on the place where it had rested; so that if it be wished to transfer a little of the gum to the wet place, one must rub it until the water has mixed with it and has attained a certain firm consistency.

The same phenomena may be observed if, instead of the thick solution of gum, a thick varnish or an oil color be placed on the finger and then the latter be placed alternately upon a dry body, or on one treated with fluid oil. The dry body will take on a share of the color equal to that left on the finger, while, by the mere placing of the finger upon it, the body treated with oil will not take on the color. In the latter case the finger may be removed without difficulty, a very small portion of the thin oil from the body treated with it adhering to the colored finger, the converse property

being shown. It is, therefore, evident that not only does water repel fatty colors, but a thin fluid repels a thick fluid; and this even takes place when they are one and the same substance, but of different fluidity and concentration.

I took a very thick solution of gum arabic, to which I added glycerin and color, and treated a lithdruck plate with the mixture. I found that this color was taken on in the same way as the fatty varnish color. The first picture, indeed, was not good, nor the second, nor the third, since the thickness, or the consistency, of the color must correspond exactly with the dryness of the gelatine film. This proportion, however, soon adjusts itself. Should the color be too thick and the gelatine film too wet, the picture will take on almost no color, but the color will draw to itself some of the moisture from the film. With the first impression a little water remains in the paper, but the film is drier, and, on being rolled a second time, already takes on more color, and so on until the lithdruck plate attains exactly the required degree of moisture. Thereafter this proportion remains constant, and the operation may be continued regularly. The gummy water-color gives off each time to the film as much moisture as the latter can absorb, thus feeding it continually with moisture, so that damping the film with water and then drying it between the pulling of each impression is rendered quite superfluous. This process is, therefore, especially suited for Schnell-press printing.

a botanical press, care must be exercised not to put too great a pressure on the specimens at first, or they will be spoiled for printing. An old book is the best for drying the examples to be used; then get a small can of printer's or proof ink and a small leather dabber, which can be bought for a few pence at any shop where wood engravers' materials are sold. Take a bit of ink about the size of a pea, and work it on a small piece of slate or glass with the dabber until it is perfectly smooth; a drop or two, not more, of linseed oil will assist the operation. Having worked the ink perfectly smooth, give the leaf a thin coating, being careful to spread it equally, not to dab it on in blotches, or the clear effect will be lost. Having applied the ink, take a sheet of paper of the size required, and lay the leaf ink downwards upon it, placing it between the leaves of an old book, which must then be subjected to a moderate pressure in a copying press, or passed between the rollers of the washing machine. If a press be not at hand, lay the book on the floor and stand upon it for a few seconds, an operation which answers the same purpose. Impressions can be taken with greater rapidity by this process than by any other, and a very little practice will enable any one possessing ordinary ingenuity to succeed in producing them. Soft book paper is the best for the purpose, and, previous to using it, place a few sheets between damp blotting paper, which causes it to take the ink still more readily. At first you will find that you lay too much ink on the leaf, which then produces too dense an impression. After a little practice you will know how much ink to lay on each description of leaf. If you find the impression too black, use the leaf once again without inking it. If the midrib of the leaf be too thick, so that the part near it does not come into contact with the paper, it must be shaved down with a sharp knife. Composite leaves, as of the umbellifera, should be divided, and their parts printed separately; other details will soon be learnt by practice.

## MANUFACTURE OF GLASS.

By M. O. SCHOTT.

In the manufacture of glass the sulphur of the sulphate of soda used is wasted and escapes as sulphurous acid. This sulphurous acid might be turned to account in the manufacture of silicate of soda, but besides that the product would attack the walls of the furnace the cost of fuel would exceed the value of the manufactured article. The author, therefore, proposes to make directly a double silicate of soda and lime by heating together sand, soda, and gypsum with the quantity of coke necessary for the reduction of these salts. This reduction does not require the complete fusion of the mixture. Thus at the same expense we can produce a much larger quantity of sulphurous acid, and a more complete saturation of the silica, which saves the walls of the furnace. The sulphurous acid produced may be passed at once into the lead chambers. The double silicate thus produced, which the author names *crude glass*, serves for the manufacture of glass if melted along with silica, soda, or lime, according to the nature of the glass to be produced. Even the proportions employed in the manufacture of the crude glass itself may be varied according to the quality intended.

One of the objections which glass manufacturers might make to this procedure is, that the gaseous escape during vitrification is necessary to render the melted mass homogeneous. But if we remember that 2 lbs. 3 ozs. of the mixture to be vitrified give off 14 pints of gas, we must agree that this quantity is much more than sufficient, and may be safely diminished. But there is no objection to stopping the manufacture of the crude glass before the complete reduction of the sulphates, or to add, for the vitrification of the crude glass, a certain quantity of unreduced mixture.

We may, in the reduction of the sulphates replace the carbon (coal, coke or charcoal), with a sulphuret, for instance, of calcium or sodium, such as the waste from the soda manufacture; the sulphurous acid is then free from carbonic acid, and its conversion into sulphuric acid in the lead chambers will go on without irregularity.—*Dingler's Poly. Journal.*

## BLEACHING COTTON.

220 lbs. of cotton are bowked for eight hours in a lye made from 64 lbs. soda crystals and 2 lbs. 3 ozs. quicklime. After washing out, the goods are passed into a chloride of lime solution for two hours, and then at once into weak acids (sulphuric) for twenty minutes. For the above mentioned quantity, 11 lbs. chloride of lime and 23 fluid ounces of oil of vitriol are required. The cotton is then carefully washed in running water and taken once or twice through a hand-warm soap beck, using to the weight of yarn above mentioned 2 lbs. 3 ozs. palm oil soap. It can then be dressed, that intended for warps with 13 lbs. starch per 220 lbs., while that for weft needs only 4 lbs. 6 ozs., a little ultramarine being added.—*Dingler.*

## PROTOPLASM.

DR. E. STRASBURGER has published a tract entitled *Studien über Protoplasma*, in which, as he informs us in a prefatorial note, he treats of the structural phenomena observed in living protoplasm, of the skin layer, of some of the differentiating products of protoplasm, and of the molecular structure of the protoplasm. Interspersed in the text are the results of some researches on vegetable spermatozooids; and he concludes with some observations on the formation of the cellulose membrane. Protoplasma he regards as a body of highly complicated structure, and the skin layer alone is capable of producing the cellulose membrane. By artificial means, Dr. Strasburger succeeded in causing swarm spores of *Vaucheria sessilis* to form three more or less perfect membranes one over the other. By the aid of osmic acid the structure of the skin layer of *Vaucheria sessilis* with its superficial hairs was beautifully revealed. The skin layer is seen to be radially pierced by numerous denser stavelets, from each of which a hair proceeds. These researches are illustrated by figures of the swarm spores of *Vaucheria sessilis* in various stages, spermatozooids of *Equisetum arvense*, plasmodium branches of *Aethalium septicum*, macrospores of *Asolla*, etc.

## COLOR IN OYSTERS.

MR. F. BUCKLAND states, in a late number of *Land and Water*, that the green-bearded oysters which are found not far from Southend, Essex, owe their green color not to any mineral pigment. This peculiar green is imparted to them by the spores of the seaweed called "crown silk," which grows abundantly in the Roach River. Dr. Letheby's analysis has pronounced this pigment to be purely vegetable, without the slightest trace of copper or other mineral. Mr. Buckland considers that this vegetable pigment imparts a peculiar taste and agreeable flavor to the meat of these plump little oysters.

## PRINTING LEAVES.

In a recent article on "Nature Printing," the *Garden* describes various methods of obtaining copies of flowers and leaves from the objects themselves. The following, which is simple and easily tried, may be of interest to some of our readers: "By those who have access to a laundry roller press, or an ordinary copying press, the following method of direct printing may be adopted: The best paper to use is ordinary wove paper without water marks, such, in fact, as is used in book printing. Those who can afford to be luxurious may use thin drawing paper. First select the leaves, and then carefully press and dry them. If they be placed in

## NEW MECHANICAL MOVEMENTS.

By H. K. PORTER, Boston, Mass.

A device, tool, or machine, having a series of triangular slides, the sum of whose central angles is equal to three hundred and sixty degrees, all being arranged to move together tangentially, and having always a common and unvarying center with solid boundaries, whereby a variable central aperture of corresponding sides may be had.

In the drawings, *a* is the frame, having a recess or internal space, with four equal sides, in which are inserted the dies *b*, each of which is formed with the four sides, 1, 2, 3, 4—line 1 bearing against frame *a*, lines 2 and 3 acting against two of the dies, and line 4 serving as a stop when the dies are fully expanded; and the limit of expansion is governed by the location of line 4 relatively between the points of intersection of lines 1 and 2 and 1 and 3.

The actuating screws, *c* *d*, are threaded in the frame *a*, as shown in Fig. 3, their points acting against the seat *e*. (Shown in die *b*, Fig. 3.) The dies or slides, *b*<sup>1</sup> and *b*<sup>2</sup>, are shown in this figure as having spaces, *f* *f*, cut in them to allow their moving past the screws, *d* *e*; *g* *g* represents a flange or plate formed upon the frame, and upon which the dies rest; *A* is a cap shown partly removed, and which, when in position, holds the dies in place. A hole in this plate corresponds with hole *j* in plate *g*, and allows a free passage for any tool which is inserted between the dies.

By retracting screw *c* and advancing screw *d*, the apex of lines 2, 3, meet at a common center, as shown in Fig. 3, and the difference between the internal area of frame *a* and the aggregate area of dies *b* is embraced in spaces *k*.

By reversing the described action of the actuating screws this open space is transferred, in any desired degree, to the center, as shown at *l*, Figs. 1 and 3.

By the combined action of these screws the dies may be "locked" with the central hole of any desired size, or by the action of screw *d* any properly formed body may be firmly screwed between the dies in the central aperture *l*.

The handles, *i* *i*, or any other device, may be employed for the manipulation of this invention.

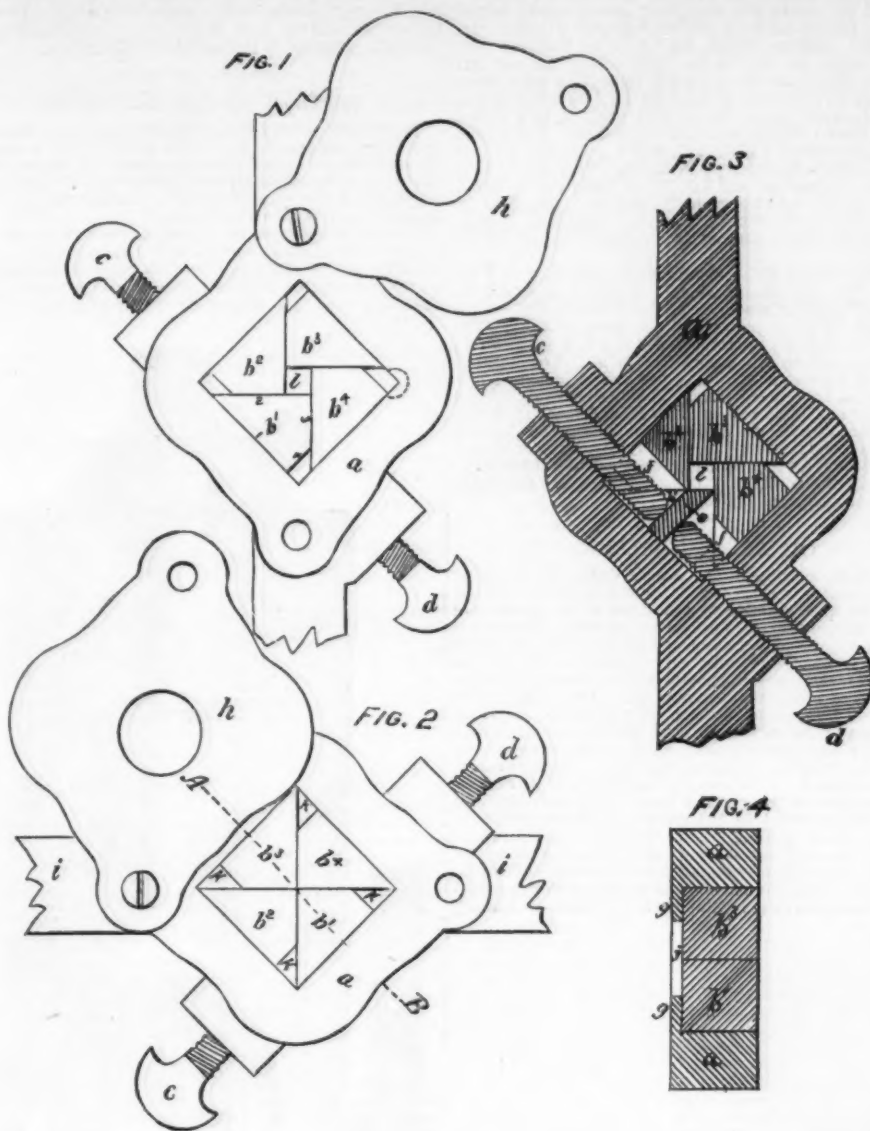
It will be apparent that three, or any desired number of dies or slides may be employed; and that this invention is susceptible of various uses and modifications.

Instead of the actuating screws *c* *d*, other devices may be employed, and the invention may be embodied in lathe or other chucks of all sizes, or for pump-pistons, instruments for demonstrating the largest square contained in any given circle, and for other purposes.

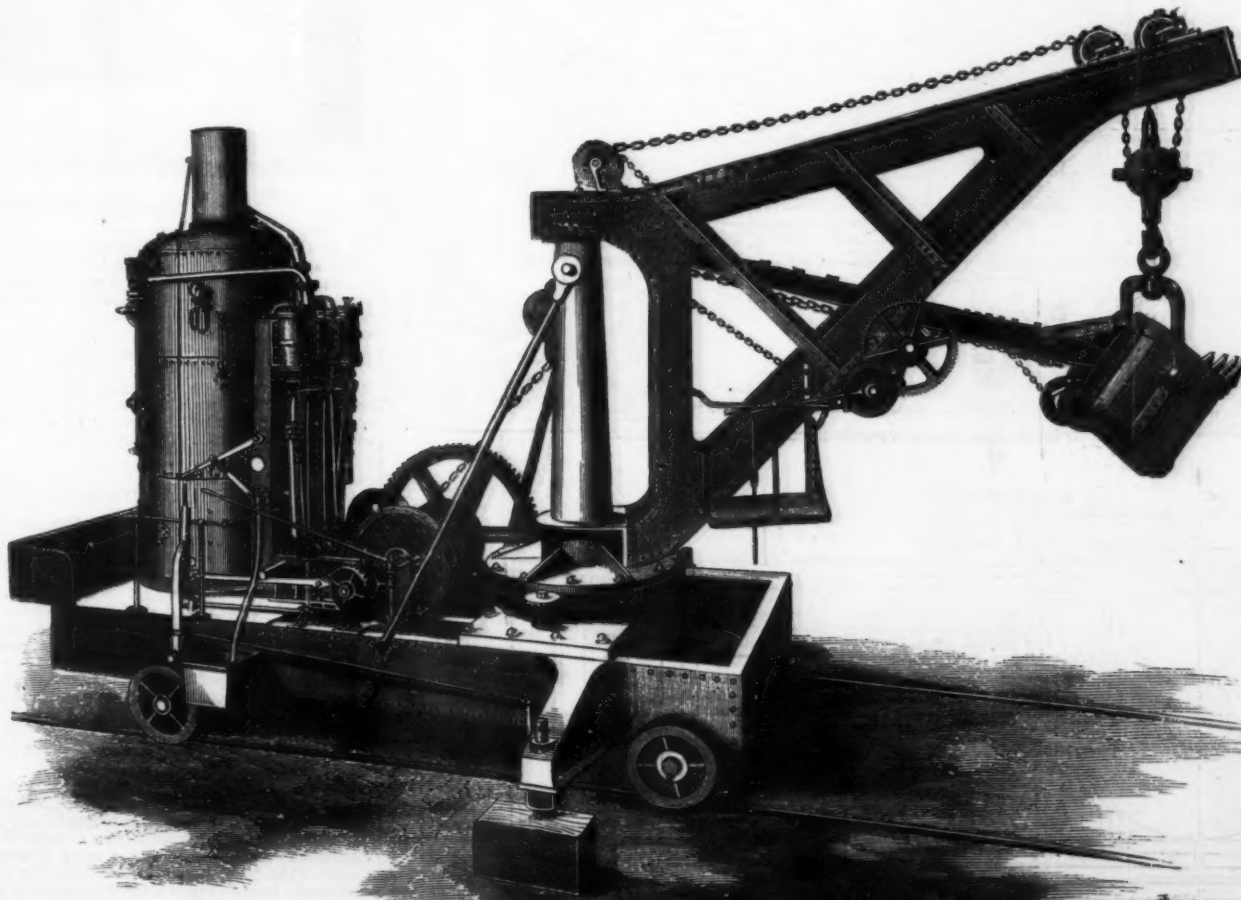
## NEW STEAM EXCAVATOR.

We illustrate a modified form of the American "steam navy," recently constructed by Messrs. Chaplin & Co., of Glasgow, Scotland.

The frame is entirely of malleable iron, with angle irons welded at the corners, plated with  $\frac{1}{8}$  in. plates, and weighing 4½ tons. Underneath the frame are two steel axles, each having four wheels, the outside double-flanged, and the inside single-flanged, set so as to work on a railway of a gauge of 4 ft. 8½ in. The front part of the frame is supplemented by two wings, one on either side, having screws, so as to give lateral stability to the machine when the digger is required to work at right angles to the line of rails. The motive power consists of a pair of 8 in. cylinders, with pinion and crank shaft, working into a large wheel on the barrel, which is grooved to receive the chain. Near the front end of the machine is a strong cast iron column, round which the jib, which is of malleable iron, is made to revolve through one-half of a circle. Two men are required to work the machine—one having entire charge of the engine for hoisting and slewing, while the other man, who stands upon a



NEW MECHANICAL MOVEMENTS.



NEW STEAM EXCAVATOR.

little platform, regulates the out-and-in motions of the digger. This man, by the use of a friction clutch and friction brake, has the entire control, pushing the digger out and in to the material which is being excavated. Simultaneously with the hoisting action or shoving out, the bucket or spoon is drawn up by pitch chain wheels, and the bucket scrapes up the face of the bank, taking a cubic yard of material at every lift. Alongside of the machine there must be accommodation rails for the wagons to come and receive the soil; and, as soon as the bucket is filled, it is slowed round by the attendant at the engine, either to the one side or the other, right over the empty wagons, and a trigger being drawn, the whole contents of the bucket fall down into the wagon. At the time a wagon is being filled at one side of the machine, another may be got ready at the opposite side.

This machine is of such a size that it will carry a cutting down to a depth of 30 ft. while it is stationed on one level. While coming up, the bucket describes a curve, and therefore does not rise perpendicularly to nearly the height mentioned. But while, step by step, it works its way inward among the soil, the support is taken from under the superincumbent earth, which thus falls down into the place excavated, to be gathered up by the spoon and deposited in the wagons. It is calculated that, by the use of the machine, the labor of eighty men will be superseded. The machine we illustrate has been built for a limestone quarry near Edinburgh.—*Engineer*.

#### PORTABLE WINDING ENGINE

We give engravings of a portable winding engine, shown at the late Brussels Exhibition by the makers, the Société Anonyme de Marcinelle et Couillet, Belgium, of whose works M. Eugène Smith is the managing director. The apparatus has been specially designed for temporary use at the shafts of mines, where the regular winding machinery has broken down, or for use in raising pump gears, etc., at shafts not fitted with fixed hoisting gear. It is proportioned for raising a load of 1½ ton from a depth of 1,650 ft. to 1,950 ft., the rope used being 0.8 in. in diameter, and weighing 4 lbs. per yard. The rope, which is manufactured by Messrs. Vélings et Cie, of Châtelet, France, is made of galvanized iron wire with a hemp core, there being imbedded in this core several copper wires insulated by a double coating of gutta-percha. The wires are led out from the rope just above the hook at the lower end of the latter, and by means of them an electric communication can be established between the cage which is being lowered and the surface. This arrangement is especially intended for use when the engine is employed to lower a rescuing party in the event of an accident in a mine.

As will be seen from our engravings, the apparatus consists of a pair of wrought iron frames of I section, mounted

on iron wheels adapted for traveling on ordinary roads. On the top of the frames just mentioned are mounted a pair of cast iron frames carrying the engines and winding gear. The engine cylinders, which are 7½ in. in diameter, with 11½ in. stroke, are fixed to the outer sides of the cast iron frames, as shown on the plan, the connecting rods taking hold of cranks at the end of the shaft, C. On this shaft is a pinion, H, which gears into a spur wheel, J, on a second shaft, D, placed directly above the crankshaft. This second shaft, D, also carries a pinion, K, which gears into the spur wheel, L, bolted to the rope drum, M. This drum, M, is 4 ft. 7½ in. in diameter and 1 ft. 7½ in. long, and it can be divided into two by a movable division ring, when it is desired to employ two ropes. The total ratio of the gearing is 18:1, the engine making 18 revolutions to one of the drum.

The valve gear is of the Hensinger von Waldegg or Walschaert's type. The boiler, which is mounted at one end between the frames, as shown, is of the vertical tubular type, the firebox being of copper and the tubes of brass. The firebox surface is 21½ square feet, and the tube surface 107½ square feet, making 129 square feet in all. The boiler is worked at a pressure of 90 lbs. per square inch, and it is fed by one of Dixon's injectors. The winding drum is fitted with a powerful brake operated by a handwheel, Q, conveniently placed for the use of the engine driver, who has also close to his hand the reversing lever, R, the regulator handle, S, the injector, U, and the steam cock for the injector, V. The weight of the whole machine is 3½ tons, and the design is neat and compact.—*Engineering*.

#### THE ART OF MOULDING.

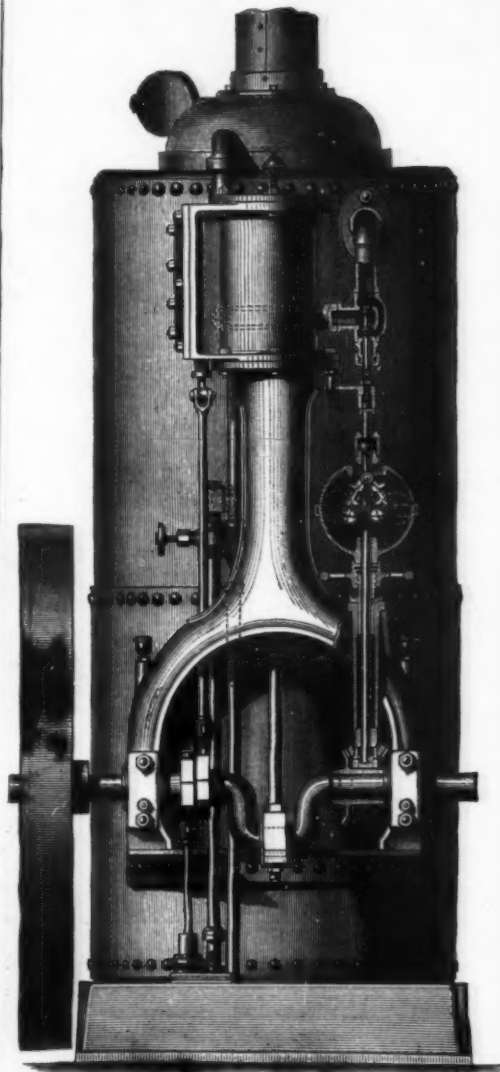
At a recent meeting of the King's College Engineering Society, London, a paper on "The Art of Moulding" was read by Mr. E. W. Anderson, son of one of the members of the well known firm of Eastons & Anderson. The author explained the different methods which are practically used in the art of moulding, and directed attention to the following general rules which should guide the moulder in the running in of the metal in moulding: 1. Choose if possible the thickest part of the casting for the runner. 2. If the casting is deep run in the metal at the bottom. 3. Where the casting has a flange in the form of a pipe it is generally preferred to run the metal in at the flange; but this case is subject to Rule 4. 4. Where the casting is thin and has many branches, or when it is of great length, it is advisable to run in the metal in the center. 5. Care should be taken to choose a place in the mould so that the metal will have no tendency to wash any part away in its first rush. 6. (This rule may be called a continuation of No. 5.) The metal should not be allowed to fall from any height upon a weak part of the mould, or it will cause the liability

to break down portions of the mould. Mr. Anderson produced several patterns in illustration of the subject to which he referred, and the tools which are used in actual work, which he presented to the museum of the college.

#### VERTICAL ENGINE AND BOILER

We illustrate a very handsome combined vertical engine and boiler, constructed by Messrs. E. R. and F. Turner, of Ipswich, Eng. One of the most noteworthy features about the engine is the extremely neat arrangement of the governor, which is completely enclosed in a polished cast iron ball, shown in section in our engraving.

All the proportions of the engine have been carefully studied. No kinds of engines or boilers have received more attention of late years, and the consequence is that in finish, safety, economy of fuel, and moderate price, they compare favorably with any other form of steam machinery, while



VERTICAL ENGINE AND BOILER.

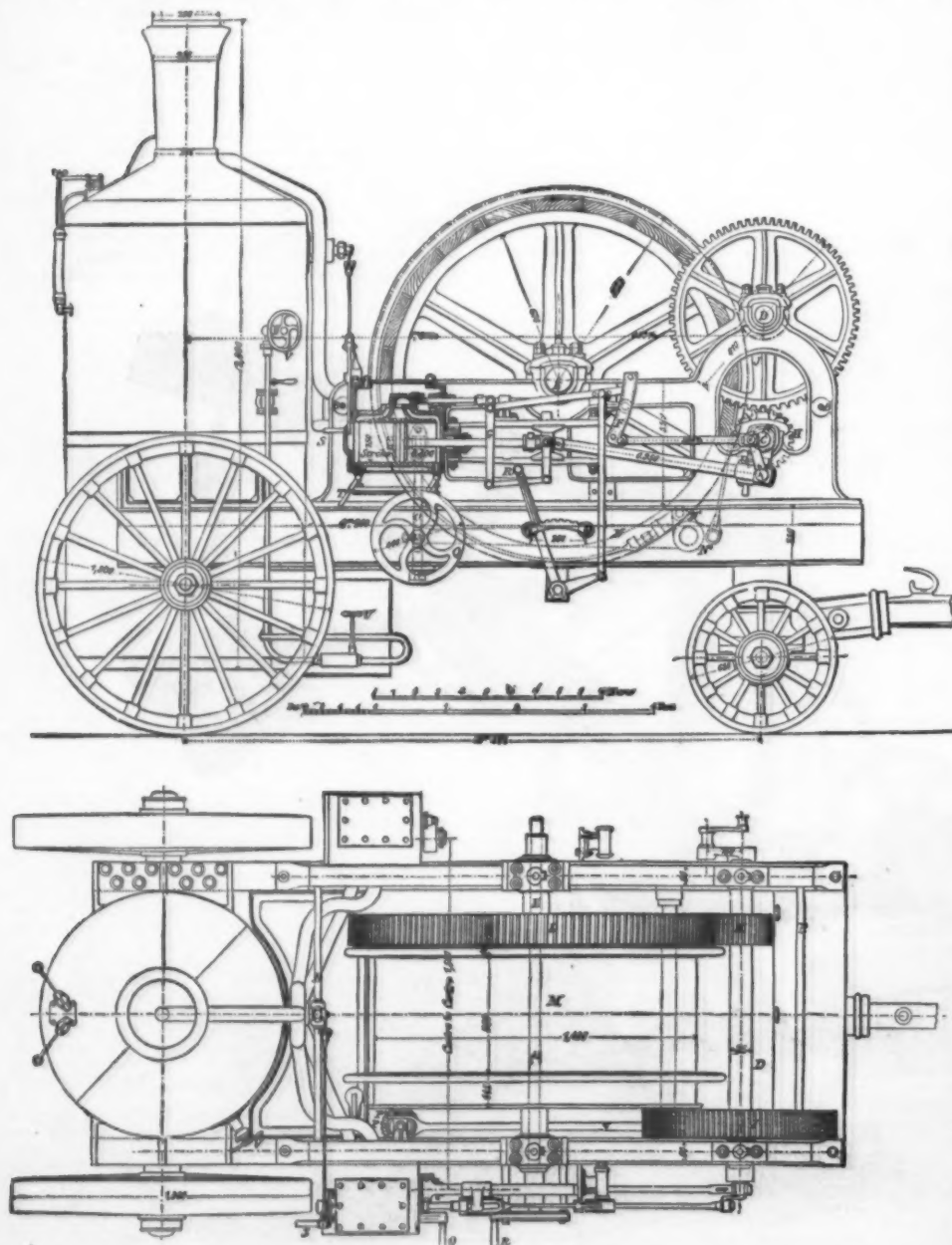
the vertical system possesses above all others the great advantage that it occupies less room than its rivals. The importance of this consideration is gradually forcing itself on the attention of users of steam power in our manufacturing districts. As much money is sometimes spent in obtaining land on which to put up engines and boilers of the usual type as would pay for the entire machinery if the vertical system were adopted. And we find manufacturers driven to their wits' end for power because they think they lack room for another boiler, who have all the time vacant corners in which a vertical boiler of 40 or 50 horse-power could be placed without the least difficulty.

#### WORKING IN COMPRESSED AIR.

It has been supposed by some that the effects of compressed air on workmen were injurious; but Siebe, an eminent German hydraulic engineer, has established, by a series of experiments during several years, the fact that workmen working in caissons attain, in a short time, a remarkable degree of comfort; and that their chests become strengthened to a remarkable degree. He has also ascertained that pulmonary complaints become cured by thus working under water. In consequence of this, Dr. Carlo Farinelli, of Milan, has established an aerotherapeutic establishment for the treatment of pulmonary complaints.—*Revue Industrielle*.

#### YOUNG'S IMPROVEMENTS IN MARINE ENGINES.

These, invented by Mr. Young, of Falcon Square, E.C., London, as will be seen by the figures, refer to annular cylinder engines, and are intended to be applied principally for working screws. With former designs of engines of this class it was necessary to have a large internal cylinder to allow for the oscillation of the connecting rod, which was necessarily long owing to its being jointed to a crosshead beyond the end of the cylinder. In the arrangement illustrated, the connecting rod may be as short as desired, and the internal cylinder correspondingly small in diameter. The connecting rod, H, can be adjusted at its smaller end by means of a box spanner taking the screw, S, when the crosshead



PORTABLE WINDING ENGINE.—BRUSSELS EXHIBITION.

F H, is projecting from the cylinder at the end of the stroke. An adjustable wearing piece is fitted in the piston for the purpose of lifting and keeping its weight from wearing the bottom of the cylinder. This piece is set up by a screw (Fig. 1) worked by means of the worm-wheel, shown at Fig. 4, the weight being carried by the small cylinder. The features of the design are clearly given by the figures; but it may be mentioned that it is claimed by the inventor that his designs secure—(1.) Short stiff piston rods. (2.) The space beyond the crank shaft not being occupied by machinery for communicating motion from the piston to the crank, is entirely free for occupation by the condensers alone, securing thus simplicity of arrangement, compactness, and accessibility. (3.) The frame bearings are close to the crank sides, no space being required to allow the piston rods to pass between the crank sides and the frames. (4.) No outer guide blocks are used, the engines being self-contained. (5.) The weight of piston equally supported from end to end of the stroke by the sliding saddle-block. (6.) Occupies a small space for a given power.

In comparison with double trunk engines, the advantages are that there are no large trunks working through large soft packed stuffing-boxes, and therefore no alternate exposure of trunks to atmosphere and steam. The space for a given power is small, and the cylinder is brought nearer the shaft by shorter framing.—Engineer.

[VAN NOSTRAND'S ENGINEERING MAGAZINE.]

NOTES ON THE HYDRAULIC AND OTHER CEMENTS AT THE PHILADELPHIA EXHIBITION.

By Q. A. GILLMORE, Lieut.-Col. Engineers, Brevet-Major General, U. S. Army.

PORTLAND CEMENT.

PORTLAND cement may be produced by burning with a suitable heat, usually of an intensity and duration sufficient to induce incipient vitrification:

1. Certain argillaceous limestones, or
2. Certain calcareous clays, or
3. An artificial mixture of carbonate of lime and clay, or
4. An artificial mixture of caustic lime and clay.

The burnt product is reduced to powder by grinding. These four methods of making this cement were all represented at the Exhibition, and will be briefly described.

**First Method.**—By this method the cement is produced by burning and grinding an argillaceous limestone containing from 77 to 80 per cent. of carbonate of lime, and 20 to 23 per cent. of clay. The stone should be a homogeneous and intimate mixture of the constituent ingredients, and the clay in it should contain at least 1 1/2 to 2 parts of silica to one of alumina. There are generally present also carbonate of magnesia and oxide of iron in small quantities, and sometimes, and not injuriously, a small percentage of alkaline compounds, but not less than 94 per cent. of the essential ingredients—the carbonate of lime and clay—should be present, in order to yield a Portland cement of first quality. The presence of carbonate of magnesia becomes seriously objectionable when its amount exceeds 3 per cent. of the whole.

Only two localities are represented by this method of making Portland cement, viz., Teil, in France, on the river Rhone, and Coplay, in the United States, near Allentown, Pa. The Teil cement is the unslaked residuum produced in manufacturing the siliceous hydraulic lime of Teil. It is burnt at a lower heat than any other Portland cement exhibited.

The Portland cement made at Coplay is produced from an argillaceous limestone which has for several years been used in making the quick-setting cement of that locality. The stone contains in suitable proportions all the essential ingredients of unburnt Portland cement, but it is not an intimate and homogeneous mixture of those ingredients, and when broken into fragments and burnt at a high heat it yields a heterogeneous mixture containing Portland cement, common cement, caustic lime, and hydraulic lime. In order to make Portland cement from it, it is first finely ground between mill stones, then tempered stiffly with water and formed into irregular shaped lumps or balls. These, after partial drying, are burnt in intermittent upright kilns, in layers alternating with layers of anthracite coal. The cement is known in the market as Saylor's Portland cement.

At Seilley, in France, a small town only a few hours ride by rail from Paris, Portland cement was made, six years ago, by M. François Colinet, by a mode essentially the same as that pursued at Teil, but none of it was in the Philadelphia Exhibition, and I do not know whether the establishment is in operation at the present time or not, neither do I know of any locality except Teil and Seilley, in France, and Coplay, in the United States, where an argillaceous limestone is found from which this grade of cement can be made without the addition of other materials.

**Second Method.**—Argillaceous chalk, or, as it is sometimes called, calcareous clay, of the same composition as the natural stone above mentioned, is used for making Portland cement by the second method, and either the wet process or the dry process may be followed. The wet process is the most common, and throughout Europe the prevailing custom is to burn it in layers alternating with gas coke, or anthracite coal, in an upright intermittent kiln.

The only locality known to furnish the material for making cement by this method is near Boulogne-sur-Mer, France, where the extensive establishment of Messrs. Longuey & Co. is engaged in this business. The material is found in the inferior cretaceous formation, and consists of an argillaceous chalk, containing from 76 to 82 per cent. of carbonate of lime and 18 to 24 per cent. of clay. The deposit is soft enough to be excavated with a pick and shovel, and it is manipulated by the wet process.

The **Third Method** consists in producing Portland cement by burning an artificial mixture of carbonate of lime and clay, and is specially applicable to localities where chalk or tender marl abounds. The hard compact limestone may also be used, although it must be borne in mind that the large consumption of power involved in the reduction of the hard carbonates to powder places them under a disadvantage which practically excludes their employment in regions which supply chalk. Suitable clay is of more rare occurrence than suitable limestone, for the reason that the former must contain silica and alumina, not only in certain proportions, but in a certain state of comminution.

All the English Portland cements are made by the wet process with a mixture of chalk—either white or gray—and clay procured from the shores or dredged from the bottom of the Medway or the Thames. The exhibitors were Francis & Co., Hollick & Co., A. H. Lavers, the Wouldham Cement Co., and Eastwood & Co., all of London. Eastwood & Co. exhibited briquettes of cement formed for testing, but none of the cement in powder.

The Scanian Cement Co., whose works at Lomma, near Malmö, Sweden, use cretaceous chalk and clay, operate by the wet process, and burn in upright kilns, with coke made on the spot from English coal.

The Wampum Cement & Lime Co. (limited), of New Castle, Lawrence Co., Penn., exhibited a cement made by the dry process from fossil limestone and clay, both being ground together in suitable proportions, and the mixture tempered with water, formed into bricks, dried in ovens, and then burnt in intermittent kilns.

Wm. McKay, of Ottawa, Canada, had on exhibition some patented cement made with a mixture of shell marl, clay, and a small percentage of carbonate of soda. It was prepared experimentally and has never been manufactured for market.

In the **Fourth Method** of making this cement, the carbonate of lime is burnt and slacked before the clay is added, and the proportions are correspondingly varied by making the proper allowance for the loss of weight by the first burning. The celebrated Vicat cement is produced by this method in France by the wet process. A sample of it, informally exhibited by an importer, did not sustain its reputation for superiority to the average Portland cements made from carbonate of lime and clay, than which it usually commands a higher price in all markets regulated by intelligent discrimination with respect to quality.

The cement exhibited by Messrs. Toepffer, Grawitz & Co., of Stettin, Germany, made from an artificial mixture of lime and clay, justifies, by its excellence, this method of manufacture.

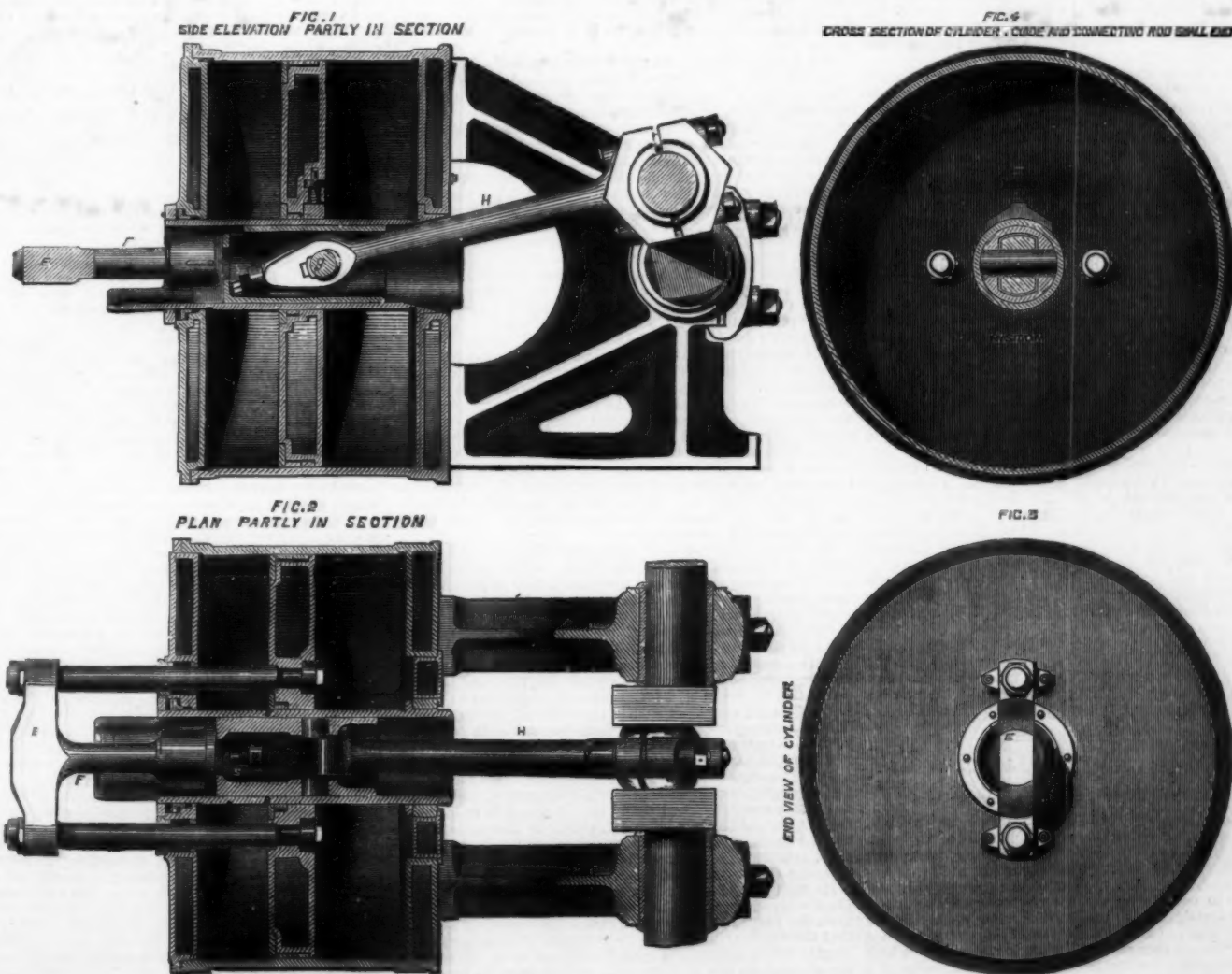
(It may be stated here that "The National Portland Cement Company of Kingston," has been organized for making this grade of cement at Kingston, Ulster Co., New York, on the bank of the Hudson River, the materials employed being fuller's earth, kaolin and lime. They are thoroughly ground and mixed together by the wet process, although much less water is employed in the manipulation than in either the English works on the Thames or in the works at Boulogne, France. Samples of this cement recently tested gave excellent results, as good indeed as those obtained with the best article on exhibition.)

Other Portland cements besides those above named were in the Exhibition, and were carefully examined and tested, but as no information was furnished with regard to kinds of materials used, and methods followed in their manufacture, no special reference will be made to them here except to give them their proper place in the accompanying table, which assigns to them their relative value.

It is hoped and believed that the manufacture of Portland cement in the United States has taken such a start that in a short time, possibly within a few months, very little, if any, of the foreign article will find a market here, except upon the Pacific Coast, where it will be procured by direct importation.

THE NATURAL QUICK-SETTING CEMENTS.

The natural light, quick-setting cements, known also as Roman cements, are produced by burning at a comparatively low heat, not greatly exceeding in intensity and duration what would suffice to expel the carbonic acid, certain argillaceous or siliceous limestones, usually containing less than 77 per cent. of carbonate of lime, or argillaceous limestones which contain less than 77 per cent. of both carbonates, and then grinding the product to a fine powder between millstones. They can be, and in Europe were formerly, produced artificially by burning a mixture of lime, or of carbonate of lime and clay, before Portland cement became known by the discovery that with certain definite proportions of the ingredients, and by burning at a high heat, the quality of the product was vastly improved. The greater value of



YOUNG'S IMPROVEMENTS IN MARINE ENGINES.



# IMPROVED TRAIN SPEED INDICATOR.

By MR. GEORGE WESTINGHOUSE, JUN.

ALL railway engineers who have been engaged in experiments on brakes, or other investigations requiring the speed of a train to be correctly ascertained, have felt the want of a trustworthy indicator which should not only show the speed of the train at any given instant, but which should also allow of diagrams being taken recording the fluctuations or diminutions of that speed caused by the application of the brake. The author is the inventor of the well known air brake bearing his name.

Mr. Westinghouse's speed indicator is shown by our engravings in two forms, that represented by Figs. 1, 2, and 3, being intended for fixing in a car, and that shown by Fig. 4, being adapted for use on an engine, the pumps for supplying water under pressure being in this latter case omitted, and water for actuating the apparatus being drawn from the boiler. In other respects, with the exception of some minor details to which we shall refer presently, the two forms are identical.

The principle upon which the apparatus acts is very ingenious, and its application to a speed indicator is, so far as we know, entirely novel. It consists in controlling the escape of water under pressure by means of a small valve loaded by the action of centrifugal force, the arrangement being such that the higher the speed at which the apparatus is driven, the greater will be the pressure exerted by certain revolving weights upon the escape valve, and the higher therefore the pressure maintained within the chamber with which this valve communicates; this chamber, we may add, constantly receiving a supply of water either from pumps or from the engine boiler. A pressure gauge, affixed to the chamber containing the water under pressure, thus affords by its indications information as to the speed at which the apparatus is being driven. Although very simple in principle, however, much ingenuity has been required to bring the apparatus into such a form that its indications shall be trustworthy in practice, as will be seen from the following description of the details of the instrument:

Referring to Figs. 1, 2, and 3, it will be seen that the apparatus consists of a base, A, forming a small water tank, there being bolted down to this base a casting, B, carrying all the rest of the parts. To one side of the casting, B, is fixed a tubular axis on which is mounted the pulley or casing, C, which is driven by a belt from another pulley on any convenient axle, care being taken, however, that the wheels on this axle are not fitted with brake blocks. Fixed to the pulley, C, is a pinion, D, which gears into a small spur wheel, E, mounted on a spindle provided at its other end with a disk crank, F. From this crank are led off two connecting rods, G G, which work small plunger pumps drawing water from the water chamber, A. The arrangement is clearly shown in Fig. 3, from which it will be seen that the pistons, or short plungers of the pumps, are forced outwards by springs, so that the connecting rods work constantly in compression, and the pumps can thus be driven at a high speed without there being any "knocking" of joints.

The two pumps deliver water through channels, a a, into

the channel, b, which is fitted with a small spring loaded relief valve, as shown in Fig. 2; this valve, when open, allowing any excess of water to escape through the hole, c, back into the water chamber, A. Communicating with the passages, a a, there is also another channel, d, shown in Fig. 3. This passage is fitted with a small check valve, as shown, and through it the water delivered from the pumps can flow up to the socket, e, into which the spring accumulator, H, is screwed, as shown in Fig. 2. The construction of this accumulator will be readily understood. It consists of an india-rubber diaphragm having on its under side a small plunger against which the water acts, while on its upper side is another plunger or piston forced downwards by a spiral spring. The lower plunger has a small rod or needle projecting from it, this needle being very slightly tapered, and the water on leaving the accumulator passing down around this needle to a channel, f, leading to a second accumulator, I. This second accumulator is similar to the first, with the exception that it is disposed horizontally instead of vertically, and by the time the water reaches it the pulsations caused by the action of the pumps are entirely destroyed. In this second accumulator the water may thus be considered to be contained at a steady pressure, the amount of this pressure depending upon the arrangements we have yet to describe.

When the instrument is fixed on an engine, and the supply of water required is drawn from the boiler instead of being supplied by pumps, the first accumulator is dispensed with, one only being employed, as shown in Fig. 4. In this case, the water, instead of entering the accumulator near the periphery and escaping at the center around a needle attached to a ram, follows the opposite course, it entering through the passage, f (Fig. 4), passing into the accumulator around the needle, g, and escaping through the passage, h, to the regulating escape valve.

Returning to Fig. 2, it will be seen that the water can escape from the second accumulator past the needle, g, into the passage, h, which is connected by small holes with a recess, i, covered by a thin india-rubber diaphragm attached to the relief valve, k. The form of this latter valve is, as will be seen, such that when raised from its seat the water flows out through a central opening in the valve into a small chamber, from which it can return through a passage shown in Fig. 2 into the water reservoir, A. We have now to describe how the pressure upon the relief valve, k, is adjusted.

It will be seen from Figs. 2 and 4 that the relief valve, k, has attached to it a rod, l, which takes a bearing against a small horizontal lever, m, as shown. This lever is also pressed against another point by the rod or spindle, o, and it will be seen from Fig. 4 that the lever is contained in a recess or mortise cut in a bar, n, so that by turning the screwed caps with which the ends of this bar are fitted, the lever can be shifted longitudinally, and the ratio which the pressure exerted by the spindle, o, shall bear to that transmitted to the rod, l, can thus be adjusted with great delicacy.

As will be seen from our engravings, the spindle, o, extends through the tubular axis on which the pulley, C, is mounted, and is provided within that pulley with the grooved collar, p, which takes hold of the shorter arms of the two bell-crank

levers, q q. The other arms of these levers carry small weights, r r, and it will be seen that as the pulley, C, revolves, the centrifugal force developed tends to spread these weights, and thus through the intervention of the bell-cranks exerts a pressure longitudinally on the spindle, o. But this spindle transmits its pressure through the lever, m, and rod, l, to the escape valve, k, and thus we see that the pressure with which this valve is loaded depends upon the centrifugal action of the weights, r.

The whole action of the apparatus will now be clear. The centrifugal force exerted by the weights, r, will vary as the square of the velocity at which the pulley, C, is driven, and hence the pressure on the escape valve, k, will also vary as the square of the velocity of the pulley, C, or, what is the same thing, the square of the velocity at which the train is moving. But a constant supply of water is delivered to the accumulator, I, from the pumps (or from the engine boiler, as the case may be), and the pressure maintained within this accumulator is controlled by the load on the escape valve, k, hence a pressure gauge placed in communication with the accumulator, I, will indicate pressures which are proportional to the squares of the speeds of the train. To connect it with the accumulator, I, the pressure gauge is screwed into the socket, s (see Fig. 4), and a gauge thus arranged is shown in the perspective view Fig. 1. From the indications of this gauge the speed of the train at any instant can be at once ascertained.

But it was desired by Mr. Westinghouse not only to be able to ascertain the speed of the train at any given instant, but to be able to take a diagram recording the decrease of speed after the application of a brake, and for this purpose the apparatus we are describing is fitted with attachments for connecting to it a suitable indicator. This indicator is connected at t (Fig. 4), at the same point as the pressure gauge. —Engineering.

## STEAM STREET CARS IN PARIS.

MR. S. S. LEE writes to the Baltimore Sun as follows: "Before leaving Paris, towards the end of October last, I determined to go and ride behind one of these motors, which had been placed upon one of the newly constructed American street railroads. Accordingly, I took a car on the upper end of the road connecting with that portion which had the motor used upon it. The road had been only a few months in use. The cars started from the Arch de Triomphe on Avenue Josephine, passed down that avenue to the Seine, which it crossed at the Bridge d'Jena, continuing on the opposite side of the river through a wide avenue, passing the Champ de Mars, near the Cavalry School, thence in rear of the Hotel des Invalides, and so on to the Mont Parnasse Station, the station of the Paris and Versailles Railroad, on the south bank of the river. From thence it continued by a wide avenue to the Orleans Railroad Station. It is this piece of railroad upon which the steam motor is used. I was fortunate in meeting the engineer, Mr. G. Broca, who kindly gave me the information which I desired.

"The motor used is two tons in weight. The four wheels are coupled, and are 70 centimetres in diameter (27½ inches), and the distance from center to center of the axles is 1½ metres (5 feet). It is boxed in like the one in use here, only there is an apron, which hides the wheels on the side and also in front. The cost of these now in use was \$2,500, but others could be built probably for \$2,000. The distance from the Mont Parnasse Station to the Orleans Station, traversed by these motors, is four kilometres (2½ miles), which is run in eighteen minutes, including the stops. The escape of steam is so controlled here as to make no noise whatever."

## THE LONDON UNDERGROUND RAILWAYS.

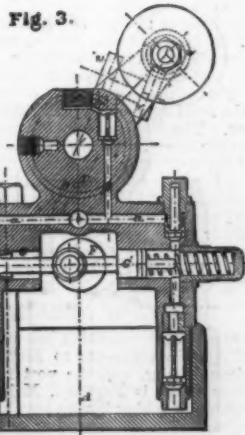
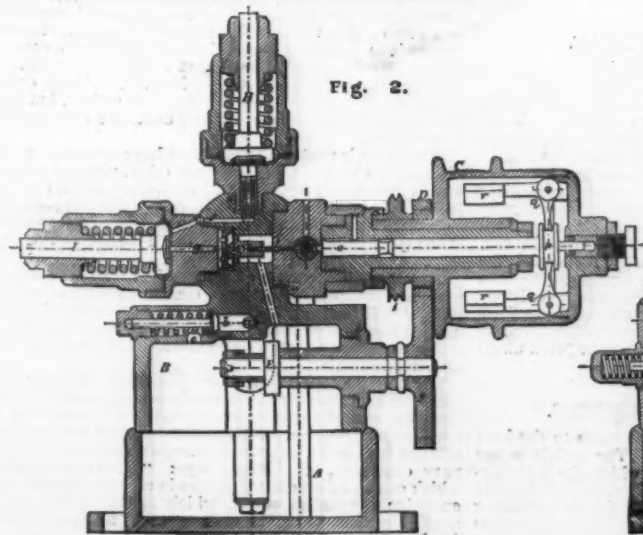
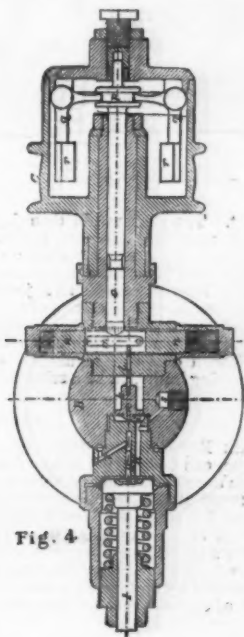
A LONDON correspondent says: The underground line is admirably managed, the only objection to it being the overcrowding of the carriages. I can very seldom get a seat in a train when I travel on it—not because I am so big, but because the "other fellows" take up all the room. This overcrowding is a great inconvenience to ladies, who use the railroad quite as much as the other sex—go about on their calls or on shopping expeditions by it, instead of taking cabs or omnibuses. I see by the last report of the Underground Railroad, presented to the shareholders, that the number of passengers carried during the last half year was 26,200,000, which seems to me an enormous number—nearly 52,500,000 a year. One would suppose that with such a traffic the road must pay well.

## RAILROAD ACCIDENTS.

THE Massachusetts Railroad Commissioners devote considerable space in their recent report to the subject of accidents. The total number of reported casualties of all kinds which occurred upon the railroads of the State during the year ending September 30, was 231, of which about one-half resulted fatally. The number of persons injured from causes beyond their own control, and for which the responsibility rests with the roads, is stated to be only one out of every 8,750,000 passengers carried. This is certainly a very small proportion—much less than usual—and speaks well for the operating management. Upon this basis the Commissioners make a computation of chances, showing that a person may travel on Massachusetts railroads 200 miles per day for 312 days in each year continuously, for 1850 years, without sustaining any injury which is not due to his own carelessness.

Calculations of this kind are very common in current railway literature, and upon their face would seem to indicate that traveling in railway cars is, if anything, less hazardous than staying at home. Taking the grand total of passengers carried, and the exceptionally small number of accidents within the period named, the estimated smallness of risk may not be very far out of the way. With the exercise of ordinary prudence, the chance of getting killed is perhaps no greater than every person runs of dying with hydrophobia; yet in spite of this infinitesimally small margin of danger as demonstrated by figures and statistics, the average railway passenger is never wholly free from apprehension. The enormous disproportion in the numbers killed and those who escape unharmed does not quite banish his fears. He can hardly glance at a newspaper without being reminded of the risk he is momentarily incurring.

NEW ZEALAND RAILWAYS.—There are now 540 miles of railway open for traffic in New Zealand, while 893 miles are in progress. It is proposed to expend a further large amount of capital in 1877, chiefly in completing the lines now in hand.



THE WESTINGHOUSE TRAIN SPEED INDICATOR.

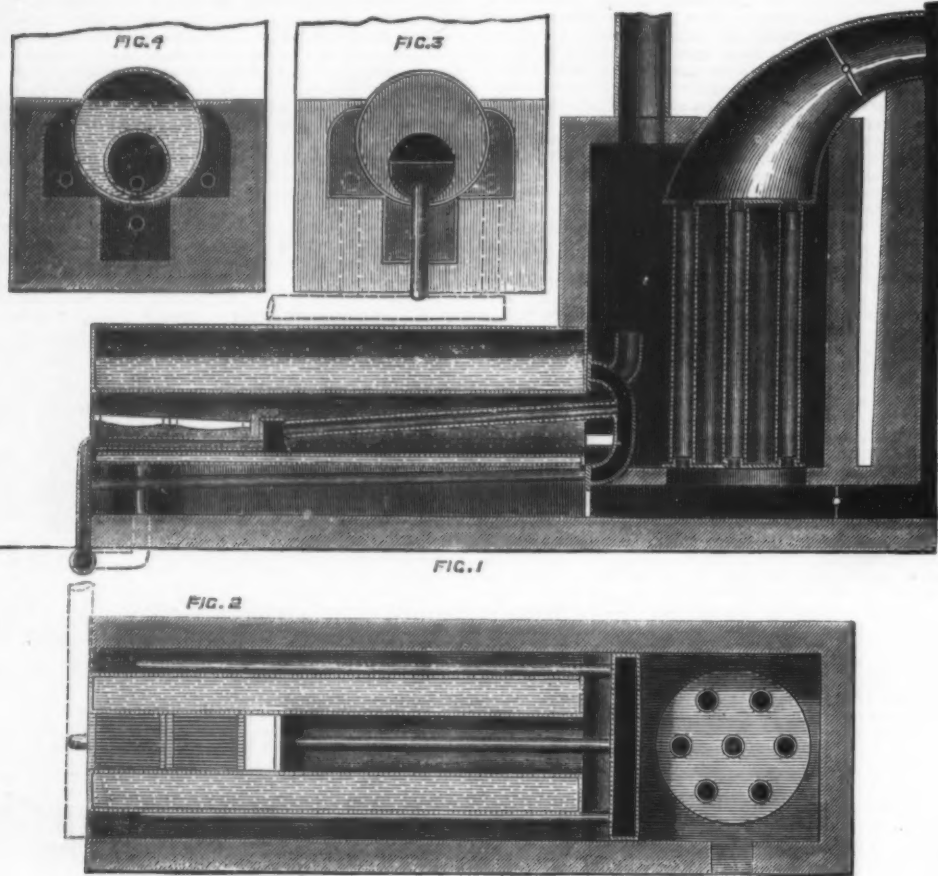
## HOT AIR DRYING APPARATUS.

We illustrate in the accompanying engraving an invention patented in England by Mr. G. F. Redfern, intended to be used by linen, fabric and cloth manufacturers, dyers, woollen dressers, brewers, and generally in all cases where heat is required for drying or warming purposes.

Our illustrations show, at Figs. 1 and 2, a longitudinal and horizontal section of an ordinary Cornish boiler, with M. Pottier's apparatus applied thereto; Fig. 3, a front elevation; and Fig. 4, a transverse section of same.

In carrying out the invention, M. Pottier places within the fire tube or tubes of the boiler an air chamber of cast or wrought iron, which is fixed at the back of the fire grate, and which is used as the bridge, being protected by fire-brick on the front and top; this air chamber communicates with the outside atmospheric air by means of a pipe or tube

sides are drawn over the concrete and tied up, when it is then ready to be lowered down to the helmet divers to set in its place, and the stream of concrete from the mixers is then turned into the other cradle, so that the operations may be continuous, and only limited by the quantity made by the mixing plant, which may be taken at about 300 cubic yards per day. The "tipping cradle," containing the bag of concrete, would be lowered down so that the men could reach it, the craft being moored as near over the place as possible. The men would have guy ropes from anchors at the sides besides them, which they would put through the rings at each end of the cradle to steady it to its place; a chock put in on the outside, and on a signal given lowered down, and the chains slackened, to take off the motion of the vessel above, the fastenings removed, another signal given to hoist, when the tipping cradle will turn over, and the bag be deposited against the last laid one as gently as placing an egg in a



## HOT AIR DRYING APPARATUS.

passing along the ashpit and communicating with an outside air pipe or tube placed beyond the ground level, and shown in dotted lines, Fig. 3. From the top part of the chamber another tube passes along the flue and communicates with another air chamber inclosing the back flue of the boiler. To this second air chamber are fixed three other pipes taking their cold air from the first cold air pipe, and which pass along in the side and bottom flues of the boiler.

At the back of the boiler, between it and the chimney, is another and much larger air chamber, in which a series of vertical pipes is fixed, and through these pipes the products of combustion pass to the chimney. At the top of this air chamber is a pipe for carrying and distributing the hot air to rooms or other places where hot air is required, either for drying, warming, or heating purposes, as the case may be.—*Engineer.*

## CONCRETE CONSTRUCTION.

Mr. R. CAIL, C.E., the chairman of the Piers' Committee, has submitted a report to the River Tyne Commissioners on a plan he has devised for constructing the piers with concrete. Although it has been patented, he offers the use of it without charge to the Commission. The plan dispenses entirely with all gearing or staging, which from past experience of its cost, liability to accident, and delaying the work, is most important. The general plan is to have one (or more) hopper barges moored across and over the site of the pier, and from it to do all the work in building the pier up to low water line, by lowering tipping cradles down through the well-way containing plastic concrete, there to be set in place by the helmet divers. The details by which the work is proposed to be done are few and simple. Mr. Cail proposes to take one of the hopper barges (or more if required), remove the doors and crossbeams, form gearing over the well-way (of such a height only as will allow four pug mills or mixers to work), and on this to form a platform to store and receive gravel, etc., for forming the concrete, which is fed into hoppers for the purpose; to make more storage on board such parts of the well-way not required to be floored over have two small steam cranes to hoist material on board, and on the platform; also to have the mixing done by steam, that the greatest rapidity and economy be obtained, and the least loss of time when the weather is suitable. The "tumbling" or "tipping cradle" is intended to be 14 or 16 feet long, and 5 or 6 feet diameter. It should be slung from the gearing over the well-way with proper tackle, one cradle on each side, the top of each being a little below the deck, that the spouts from the mixers can run the liquid concrete into either cradle requiring to be filled. A bag made of jute cloth, the length and capacity of the cradle, is placed in it, the middle being left open and laid back over the sides of the cradle to allow the concrete to be poured into it from the mixers, and as the bag is being filled the concrete to be trimmed and made solid. When the bag is filled, the two

basket. The men would then beat it into shape where required ready for the next course. As the bags would be somewhat loose over the plastic concrete, it would accommodate itself to all the inequalities of the bed, and the adjoining bag, somewhat like joggles, giving firmness and solidity to the work; closers of any length can be sent down, and loose concrete to fill any small space, if required. By this means the bags can be carefully set or built in regular bond with ease and regularity, and in three or four hours after being built will be a solid mass.

## THE ROYAL ALBERT HALL.

THE Royal Albert Hall, London, which holds 7,000 people, can be emptied in less than seven minutes, as there is one door of exit for each 200 persons. On the roof there are twenty tanks, each containing 2,000 gallons of water, supplied from an artesian well at the back of the building; these if emptied can be refilled in twenty minutes. There is also a special high-pressure service surrounding the building, with six fire-plugs. All the fire appliances are inspected weekly by an inspector who is not one of the ordinary staff of employees of the building.

## HOW TO PREPARE RAW MEAT.

RAW meat is now used to a considerable extent as an agent of hygiene and therapeutics. The following directions with regard to it, from the *Journal de Pharmacie*, may not be without interest: Beef is preferable to mutton. The fat should be removed (one reason being that it may contain cysticercus). The best part is the rump steak. The fibres are here best suited for rasping (*rapage*) in longitudinal direction. This is the best mode of division. Chopping removes from the meat most of its juice, and does not give such good division. The rasping is done with a sharp knife-blade—the sharper the better. The piece of meat should be pretty thick, and of lozenge shape; the rasping can be done on all the facings, in the natural direction of the muscular fibre. The piece should rest, held by one end, on a resistant and slightly inclined plane. The meat is generally reduced to the form of a pill or bolus, which is rolled in powdered sugar or crumb of bread. If it cannot be taken thus, it may be given under the mask of bouillon, which should be cold.

## EXPORT OF AMERICAN LOBSTERS.

AN experimental addition has just been made to the long list of American exports to England. The article is the American lobster, and the port from which the first shipment was made is Portland, Maine. For some years past the Portland packing houses have shipped the canned lobster to England in ever increasing quantities. The taste thus acquired has created a demand for the article in a fresher and more palatable state. To supply this demand the Port-

land firm of Marston & Sons, extensive dealers in fish, have conceived the idea of shipping live lobsters by means of the English steamers which ply between Liverpool and that port. On Saturday last the Dominion steamship Sardinian took out the first consignment of this novel merchandise. On her main deck was built a tank 20 feet long, 8 feet wide, and 3 feet high, with a cover working on hinges. Through this tank a stream of salt water, pumped from the ocean by a donkey engine, and supplied by six faucets, constantly flows. The present occupants of the tank are 700 live lobsters. The projectors of the enterprise are confident of its success, their only fear being that the change from excessively cold water to that of the comparatively warm water of the Gulf Stream may prove disastrous. Should the experiment prove successful, it will lay the foundation of an important business, and is therefore being watched with interest by the numerous lobstermen of the eastern coast.

## THE MANUFACTURE OF COCOA.

In a recent number of *Hand and Heart* we find some interesting details concerning the preparation of cocoa and chocolate as carried on in the works of Messrs. Cadbury Brothers, of Birmingham. From this article we select the most interesting paragraphs:

It appears that the Spaniards were the first Europeans who tasted chocolate; it was part of their spoil in the conquest of Mexico. Bernardo de Castille, who accompanied Cortez, describing one of Montezuma's banquets, says: "They brought in among the dishes above fifty great jars made of good cacao, with its froth, and drank it," and similar jars were served to the guards and attendants "to the number of two thousand at least." Gage, an old traveler, who had visited the tropics, writing in 1690, remarks: "Our English and Hollanders make little use of it when they take a prize at sea, as not knowing the secret virtue and quality of it for the good of the stomach."

In the reign of Charles II. it was so much esteemed in England that Dr. Stubbs published a book, entitled, "The Indian Nectar; or, a Discourse Concerning Chocolate, etc.," giving a history of the article and many curious notions respecting its "secret virtue," and recommending his readers to buy it of one Mortimer, "an honest though poor man," who lived in East Smithfield and sold the best kind at 6s. 8d. the pound and commoner sorts for about half that price.

Linnaeus was so fond of chocolate that he called it food for the gods in the distinguishing name he gave to the tree that produced it—Theobroma Cacao.

The tree is a native of tropical America, but is now largely cultivated in other parts of the world. It is an evergreen and grows to the height of from 14 to 18 feet. It bears flowers and fruit at all seasons of the year; these grow out of the trunk and thickest part of the boughs. The little yellow flowers are in clusters, and the fruit when ripe is of a beautiful orange color. As the plant cannot bear the intense heat of a tropical sun, it is shaded by rows of loftier trees, as bananas, or more frequently the erythrina or corallina, called by the Spaniards madre de cacao, a tree with superb red blossoms.

The nuts are taken from the pod as soon as collected, and covered with a layer of sand. This causes a fermentation, which develops the aroma and takes off the natural bitterness of the nut. They are then spread out to dry in the drying or curing house. This house consists of a strongly built span roof fixed with wheels, running on iron rails laid along a stout framework, which supports a platform, underneath and upon which the cocoa beans are dried.

Prior to 1841 the quantity of cocoa annually consumed in England had not reached half a million pounds, whereas it now amounts to over nine millions.

The Birmingham works have become widely extended. Fifteen years ago only about thirty hands were employed. The number now is from three to four hundred. During this time also so many improvements have been made in the arrangements and machinery that an equal number of hands now represents a double production as compared with the former time. This will give some idea of the largely increased consumption of cocoa. The greatest attention is paid in the factory to cleanliness; the young women employed are all clad in a kind of uniform of clean brown holland, covering the whole dress. From 9.30 to 9.15 every morning an interesting sight may be witnessed in the factory. The workpeople—men and women—assemble for a short and simple religious service. Some of the employés, as a choir, conduct the singing; and snatches of the tunes often heard over the work during the day indicate the interest felt in the morning service.

The bags of cocoa, as they arrive from the docks, are stacked up in large piles. They come from different parts of the world—from Trinidad, Grenada, Caraccas, Carupano, Surinam, and even from Africa, and there are a few other choice and special varieties.

These cocoa nuts or beans are carefully sorted, and the unsound ones rejected; they are then placed in rotating cylinders and subjected to a gentle heat over coke fires, until the full aroma is properly developed. When cooled they are passed to another room, in which machines are arranged for breaking the now crisp, roasted nut into the irregular segments into which the kernel is naturally divided. The next process is to remove the outer husks by means of a powerful blast. The rich glossy kernel that remains is known in the market under the name of Cocoa Nibs. The husk or shell is sent off to Ireland, where it is used as a light, but by no means unpalatable, table decoction, under the designation of "miserables."

The visitor is next conducted into a large room where series of stones are working, one over the other, much in the same way as in ordinary flour mills. Between these the nibs are passed, and, as the stones are heated, the nibs are reduced to a creamy fluid, which flows into pans placed to receive it. When quite cold this will turn out a perfectly firm, hard cake.

Up to this point we have the cocoa in its native condition, with the exception of the acids, etc., thrown off in roasting, and the shell removed by the fan. We now diverge into three distinct branches of manufacture; and as the Cocoa Essence is the product of the firm best known to the public, we shall give it precedence.

There is no sophistication in this article; it is the same cocoa we have seen running from the stones in a creamy fluid, with the excess of cocoa butter removed. The best cocoa contains about fifty per cent. of natural cocoa oil or butter, and this has been found to be far too large a proportion for ordinary digestions. Dr. Muter says: "The only objection which can and does exist to its use in a state of purity is the excessive proportion of fat, which renders it too rich for most digestions, and gives, unfortunately, a colorable excuse for its adulteration."

Messrs. Cadbury Brothers have therefore paid great atten-

tion to the production of a pure article free from this objection. The removal of two-thirds of the butter is accomplished by means of very powerful and complicated machinery, the result being an impalpable powder, soluble in boiling water and possessing the nutritious gluten and stimulating theobromine in an increased ratio; so that Cocoa Essence perhaps stands highest among dietetics as a flesh former and nutritious beverage.

Still there is a demand for cocoa that thickens in the cup; and this comprises the second branch of manufacture to be examined. A given portion of the liquid cocoa is poured into a large steam-heated pan, and weighed with the sugar, arrowroot, etc., which, of course, differ in kind and quantity, according to the value of the chocolate powder required. Strong iron arms are then set in motion, which so completely levigate the mass that in a few moments it is reduced to a powder. These chocolate powders are sold under the names of Homoeopathic, Iceland Moss, Breakfast, etc.

It is a relief, after witnessing these manufacturing processes, to mount into the packing department above; for, however interesting the results witnessed below, one grows tired of the incessant noise and clatter of the machinery. In the packing room all is light, cheerful, and orderly. We watch row after row of girls busily engaged. One is weighing, a second is packing and enveloping in cases of bright tinfoil, a third is fastening on the outside labels of the Cocoa Essence and other preparations now so well known all over the world.

The third branch of manufacture yet to be noticed is that of sweet chocolate for eating and drinking; and here again we have numerous varieties. In the first place the pure cocoa is incorporated with white sugar in what is called a "mélangeur." This is a round stone basin in which the cocoa and sugar are placed, and which revolves at a great speed, while two heavy stationary rollers bruise the mass until it becomes of about the consistency of dough. From these mélangeurs the mixed substance is at once passed through machines with three granite cylinders which crush it still finer, and in this state it is ready for moulding into the various shapes and sizes for sale.

The best chocolate is flavored with vanilla, which is the fruit or seed pod of one of those beautiful species of the family Orchidaceæ that flourish in tropical America. The stems climb to the height of twenty or thirty feet, twining round the trunks of trees, and throwing out a profusion of aerial roots, some of which eventually reach the ground. It seems especially adapted for flavoring chocolate, and is used principally for that purpose.

Cocoa carefully selected and prepared in this way certainly forms the most delicious of all beverages or confections. The firm make a special article of this kind, packed in blue wrappers, which may fairly be compared to the famous chocolate that Prescott describes as forming a part of Montezuma's repast: Chocolate "in golden goblets flavored with vanilla, and so prepared as to be reduced to a froth of the consistency of honey, which gradually dissolved in the mouth."

#### THE CLEANSING OF PARIS.

By M. VAISSIERE, Chief Engineer of Roads and Bridges.

[The thorough and systematic cleansing of the streets in Paris is recognized as one of the most important duties of the municipal government. Its performance involves the labor of a large and complex organization, established by law, and directed by engineers educated in the Government service. The *Annales des Ponts et Chaussées*, the official organ of the Bureau of Administration of Bridges and Roads, contains the following valuable paper on the subject. We omit such portions as are *résumés* of old laws, and which involve details of localities of no particular interest to our readers.—*Eds.*]

A TREATISE on the cleansing of Paris may be divided into five parts, relating respectively to: 1. *Personnel* of the organization. 2. *Materials and disinfectants*. 3. *Sweeping of streets and of markets, mechanical sweeping*. 4. *Removal of filth, snow, and ice*. 5. *Street watering*. Each of these heads will be made the subject of separate consideration.

##### 1. PERSONNEL OF THE ORGANIZATION.

The service is supervised by two chief engineers—one directing the first division, consisting of ten *arrondissements*; the second, the second division, of a like number of sections of the city. There are three assistant engineers in the first and four in the second division; each engineer in the first case governing three (in one instance four), and in the second, two *arrondissements*.

The engineers have under their orders 51 managers (*conducteurs municipaux*) and 61 overseers. The Inspector General of Roads and Bridges, Director of Public Works in Paris, has general control of the entire service—the actual wages of the individuals of which, not including salaries of engineers, amount to \$52,000 per year.

##### 2. MATERIAL AND DISINFECTANTS.

The constant care which is necessary to insure cleanliness of the streets requires that a large supply of material be always immediately available. In the 1st division this material is stored in a central depot, under the supervision of an engineer, and in charge of an agent under bonds for its proper conservation. The material, which consists of tools, instruments, etc., is issued to the proper officials as required, and the latter are rendered accountable for the same until returned. All tools or implements injured are at once turned in to the depot and new ones taken in exchange. A regular system of books is kept, showing the issuing and return of every article, and the length of its service. Damaged material is yearly sold, and replaced by perfect articles. In this way the depot is kept supplied both with the tools, etc., daily required, besides a large extra reserve, to be used in case of an extraordinary demand, such as might occur after a heavy snow fall. In the second division the topographical peculiarities prevent the establishment of any central depot. There are, therefore, several magazines, in each of which the above rules hold. Repairs and supply of new articles are here usually undertaken by contractors, subject to a special rate of charges.

##### DISINFECTANTS AND CLEANSING AGENTS.

These are stored in the depots. The disinfectants are:

*Chloride of Lime*.—The chlorine disengaged decomposes hydrosulphuric and sulphurous acids, ammoniacal salts, hydrogenated gases, and all the volatile products arising from the fermentation of organic matters. The chloride is used with especial success against fecal matter and foul gutters. For the cleansing of the latter it is mixed in the proportion of 2.2 lbs. to 20 quarts of water.

*Sulphates of Iron and of Zinc*.—Both are employed under similar conditions. They destroy sulphuretted hydrogen, ammonia, and ammoniacal salts; cause the disappearance of

the arising bad odor in great part, but exercise no appreciable action on organisms or on volatile matters of fetid odor due to the decomposition of organized bodies. 2.3 pounds of the sulphates are employed in 10 quarts of water. They are especially useful for the disinfection of receptacles for offal from markets. Sulphate of iron leaves a layer of rust on objects with which it comes in contact. Sulphate of zinc is the more energetic, but is more expensive. It is chiefly employed for cleansing fish and poultry markets. Diluted  $\frac{1}{2}$ , and mixed with 8 per cent. sulphate of copper, sulphate of zinc makes an excellent disinfectant (*Eau Lanaudie*) for private houses.

*Carbolic Acid*.—This is not a true disinfectant. It does not act on odorous bodies as does chlorine. It arrests fermentation, doubtless, by destroying the germs and ferments, and should be used wherever it is desired to kill such results of putrid fermentation. A solution of 1 quart of acid in 40 quarts of acid may be employed. In infected places, as well as in markets, etc., dilutions of from  $\frac{1}{10}$  to  $\frac{1}{15}$  are useful. A dilution of  $\frac{1}{10}$  is excellent for watering streets, markets in summer, and gutters containing foul liquids. Carbolic powders, sulphate of aluminum, heavy gas oils, and various other products have been tested, but have been abandoned owing to their odor and color.

The cleansing agents are:

*Hydrochloric Acid*.—This is useful for urinals and for washing walls. It is indispensable in slaughter houses. For urinals covered with thick tartar deposit, 1 quart of acid to 5 quarts of water is employed; for walls, the proportion is 1 in 10; and for ordinary washing, 1 in 15. The acid leaves a disagreeable odor after use, which, however, soon evaporates.

*Nitro Benzine*.—This is more energetic than the preceding. It leaves a disagreeable bitter-almond odor and a whitish deposit, which last is readily washed off with water. The dilutions are the same as for hydrochloric acid. Both substances oxidize metals and other fabrics, and hence caution is necessary in their use. Dilutions of  $\frac{1}{10}$  are harmless.

The annual expenses for material and disinfectants amount to \$44,000.

##### 3. SWEEPING OF STREETS, MARKETS, ETC.

The author here quotes laws relative to the cleaning of Paris, dating back to the reign of Philip the Bold, in 1285. In 1285 laws were enacted by which every citizen was compelled to repair and clean his pavement under penalty of a fine. After Paris had been remodelled by Baron Hausmann, and the old, narrow streets replaced by wide avenues and boulevards, the laws which required the householder to cleanse a certain part of the roadway were no longer found fully effective, and accordingly ordinances were framed whereby the city undertook all the work and taxed the citizens to pay for it. The amount of the tax depends upon situation, and it varies from 2 cents to 14 cents per square meter (10.24 square feet) per year. The citizen is not taxed for over half breadth of street, or 6 meters, all space above being charged to the city. The total area of the streets is 14,500,000 square meters, on 8,000,000 of which the landlords are individually taxed. But the sidewalks are not swept by the municipal employees, and their area, 3,700,000 meters, is to be deducted, so that the total superficies to be swept is 10,800,000 square meters, or nearly four square miles.

The sweeping of this immense area takes place from 3 to 6 A.M. in summer, and from 4 to 7 A.M. in winter. During the subsequent two hours the carts for removing the accumulations make their rounds. The loading of the vehicles is done by the driver and two assistants. After the general morning sweeping the workmen are set at whatever special work may be necessary. Some cleanse the gutters (this is done twice a day), others disinfect and water the streets, others wash the public urinals, and clean the police stations. Labor of this kind stops at 4 P.M., unless for some special reason, as when it becomes necessary to cover steep icy streets with sand, or sweep before public edifices. This involves, however, extra expense. In all there are 8,000 workmen, divided as follows: 2,200 men at wages of from 50 cents to 80 cents per day; 950 women at 4 cents to 5 cents per hour; 30 children (boys) at 4 cents per hour. The workmen are distributed in 123 gangs, each consisting of a chief and 30 or 16 men, according to the division wherein they labor. Besides this army of sweepers are the sweeping machines, of which there are 190. As one machine does the work of ten men, the general sweeping force may be placed at 4,900 laborers. Paymasters are allotted to each division, and there is a regular system of appointments of applicants for the various positions.

The sweeping and cleansing of the halles and markets requires a special force—60 workmen, duly officered, attend to the sweeping—20 work from 6 to 7 A.M., the remainder during the day. During summer 15 extra hands are employed to remove vegetable refuse, etc. The sweeping continues in all the various parts of the buildings until 1 or 2 P.M. At 4 P.M. the wholesale markets are cleaned. While this work is in progress the scavengers attend to their labor, and, finally, at 8 P.M., the cleansing for the day is over. The morning's sweeping is always preceded by covering the floors with wood shavings, so as to absorb liquid refuse. Then the floors are gone over with hand brooms, and the mechanical sweepers finish the work.

The washing is done with carbolic or chloridized water, and the floors are thoroughly dried with the squeegee, or rubber scraper. The removal of refuse is effected by carts, twice a day for organic filth after each sweeping; and after 6 P.M. for any waste left in the stalls by the retail dealers. Fragments of fish or meat are hermetically sealed up in cans containing about 330 pounds each. Cranes and elevators are provided in the passages for the hoisting of the materials from the cellars.

The mechanical sweepers are of two kinds, both, however, being of simple construction. A frame on two wheels carries in the rear an inclined roller, on which the broom is spirally disposed. This is rotated by gearing from the wheels, and is thrown into or out of action at the will of the driver. A single horse suffices for traction. The cost of the apparatus is about 200 dollars; and for repairs, renewal of brushes, which last about 180 hours, etc., its yearly expense is about 54 dollars. One sweeper can clean 5,500 square meters per hour. The total cost for workmen and machines amounts to \$584,000 per year.

##### 4. REMOVAL OF FILTH, ETC.

As has already been stated, this is done by carts after the morning's sweeping. The work is performed under contract, and is let by sections to bidders. The material removed is the product of the sweeping, household garbage, and the market refuse, and does not include sand, ashes, oyster shells, or merchandise waste. About 530 drivers, the same number of carts, and 990 horses are employed; all of which the contractor finds. The Government supplies the assistants, men or women, who aid in loading the carts. The

amount of refuse daily removed would make a mass equal to 55,705 cubic feet. The contractor supplies all tools, and is responsible for the work and the behavior of the workmen.

The establishment of the contract system is of recent date, and it is also comparatively lately that citizens were forbidden to expose swill, etc., on the sidewalks, and were made to deliver it to the carts directly. With the disappearance of the garbage boxes the occupation of the rag picker—the famous Parisian *chiffonnier*—was gone. These people fought vigorously against the new laws, and ravaged the carts whenever opportunity offered, dumping the contents of the vehicles on the street, but the police have finally conquered them, and the calling is gradually dying out. The *chiffonniers* were formerly licensed by the police, and over 7,000 were registered. It is probable that as many more were unknown. Each individual could, on an estimate, make 30 cents a day; some of especially sharp eyes picked up stuff from which they could realize perhaps 60 cents. With 15,000 people plying this business, it is evident that its aggregate returns were large, and it is stated that they reached over a million and a half of dollars per year. The *chiffonniers* themselves are now employed regularly by the contractors to overhaul the collected garbage, so that their penetrative skill still serves them as a means of livelihood.

*Removal of Snow and Ice*.—"This," writes our author, "is an exceedingly difficult, onerous, and thankless task, as, whatever the zeal of the officials, they rarely can satisfy the just impatience of the public." An elaborate series of instructions of how to remove the snow from sidewalks, what gutters to open, etc., etc., for the different streets, is issued to the citizens by the Prefect of the Seine. The snow, as a rule, is to be swept to the edge of the sidewalk, but it is expressly forbidden to throw it in the street. Carts then come and remove it.

The municipal workmen sand the streets and remove the snow from the large thoroughfares, the principal ones being first cleaned. Of the carts used, the omnibus company is compelled by its charter to furnish fifty two horse vehicles; the rest are those belonging to the street cleaning contractors, who are obliged to place them at the disposition of the engineers. A considerable portion of the snow is thrown into the sewers, into which hot water from factories runs. After a thaw care is taken that the sewer apertures are all open, and the entire force of cleaners is set at work. Labor is then continuous until all the slush and mud has been cleaned away. Various attempts have been made to remove the snow by melting it by steam jets, but have all proved wholly unsatisfactory. After the jet had made a hole of a certain depth in the snow, its action seemed to be annulled. (Experience with similar machines in this country has also proved unsuccessful, as none of the many devised on the steam jet principle have attained practical results of any value.—*Eds.*) The snow cleaning brigade has a regular organization of its own. Each man knows his particular duties, and hence, when all are suddenly called upon, their work is promptly and thoroughly executed.

The total cost of cleaning and snow removing, as detailed above, is \$181,600 per year.

##### 5. WATERING THE STREETS.

This is done by water carts and by hose. The type of vehicle commonly employed is a sheet iron paralleloped, on which the driver is seated. By simple mechanism he controls the outlet. These vehicles are provided by the city, horses and drivers by contractors. The tank contains about 300 gallons of water. This is sufficient to sprinkle an area of about 2,500 square feet. One vehicle is allowed to every 200,000 square feet of paved, or half that area of unpaved, surface.

The hose used is supported on carts, and is about 50 feet in length. One man can thus easily water an area of about 200,000 square feet in half an hour. The cost of watering with hose is about half that of watering with carts.

Numerous trials have been made of solutions of deliquescent salts for watering purposes, the object being to do away with the constant traveling to and fro of the carts, and the frequent too plentiful production of mud. At first, refined chloride of calcium was used. This does not dissolve completely in water, and hence could not be applied by either hose or carts. Its solution was therefore sprinkled over the streets from hand vessels. The quantity used was about half a pound in solution per ten square feet, and the effect lasted for from 5 to 6 days. Experiments were subsequently made with crude chloride of calcium, containing chloride of manganese, and costing about half as much as the foregoing. Twice as much of this substance was required per same area as of the pure chloride, and it kept down the dust only three days. A favorable report was therefore made on the refined chloride, but it was found that the cost of using it was about seven times as much as watering by the usual method. Subsequently pure chloride of magnesium was tried, but the use of it was also too expensive, costing three times more than the water carts and hose. At present it is not deemed advisable to use salts, except in case of the water supply running low, of which there is no visible likelihood. The yearly cost of watering Paris is \$90,000. By adding all the separate items of expense above given, it will further be seen that the total cost of keeping the great French capital thoroughly clean and disinfected the whole year round is less than one million of dollars.

##### OIL REFINING IN CALIFORNIA.

THE Los Angeles *Herald* speaks as follows of the oil interests of southern California and the progress of refining:

The present development of the oil interests of Los Angeles county will render interesting some notes of the progress of refining hereabouts. About four years ago, a refinery was established in the San Fernando oil region by a stock company. It was placed under the charge of a superintendent named Smith. This gentleman could not get a satisfactory percentage of light oil from the heavy crude product. About 18 months ago the refinery passed into the hands of Messrs. G. D. Scott & Baker. These gentlemen were a little more successful than Mr. Smith had been, but they also failed to secure the best results. They were succeeded by a Mr. Shoemaker, of Akron, Ohio, with a like record of failure. Determined to make a success of it next time, Mr. J. A. Scott, a noted refiner of the Pennsylvania oil regions, was sent for, and his handling of the refinery was attended with entire success. He remained in the San Fernando district until his presence was called for at Ventura, to take charge of the California Star oil refinery.

Mr. Scott, we are now informed, is turning out of the works there some 30 barrels of refined oil daily, with very limited facilities. The gross product of the Ventura wells and springs is about 80 barrels of crude petroleum a day. The wells there are down to a depth of about 140 feet. At

San Fernando there are five producing wells, and the gross product of crude oil daily is about 40 or 50 barrels.

It should be stated that the oil of the San Fernando district is of a much finer grade than the Ventura article. It refines much more satisfactorily than the latter, and yields a much larger percentage of illuminating oil.

There is a lively demand for the petroleum of southern California in San Francisco and throughout the State at large. As refined by J. A. Scott, it is regarded as superior to any oil imported from the East. The oil producers at San Fernando labor under a disadvantage from which their Ventura brethren are free, notwithstanding the lighter gravity and consequent greater value of the Los Angeles product. A pipe is now being laid from Ventura to Wheeler's canyon, a distance of 27 miles, and its owners promise to pipe oil to Ventura for \$1 a barrel. From Ventura it is carried to San Francisco for 75 cents a barrel by ocean vessels. Thus the whole cost of its transportation there from the spot where it wells out of the ground to its market in San Francisco, is \$1.75. It costs the San Fernando producer, on the other hand, just \$3 a barrel to get his oil transported to San Francisco via the Southern Pacific Railway.

The Los Angeles and Ventura oils, as refined by Mr. Scott, command about 40 cents a gallon. As there are about 45 gallons to the barrel, a barrel of this oil is worth in the San Francisco market about \$18. Mr. Morrison, an experienced oil refiner of Pennsylvania, has been sent for to take charge of the San Fernando refinery, and he will doubtless obtain results as satisfactory, in the manipulation of the crude petroleum of that section, as those achieved by Mr. Scott.

The outlook for oil production in southern California is emphatically promising. We have a better record from our oil wells to-day than the Pennsylvania wells showed at the same stage of development. Experienced Pennsylvania oil men assure us that the probability of a yield quite as prolific as that of Pennsylvania, at some time, is great. Patience, perseverance, and some outlay in sinking the wells to the required depths, are all that are needed. One or two failures should not dispirit prospectors. The fortune of the Pennsylvania, Ohio, and West Virginia pioneers was the most variable thing in the world. One man would strike it and a man 50 feet away from it would fail. Until some wells have been sunk to a depth of 1,400 or 1,500 feet we cannot be said to have begun to prospect for oil. The kind of well boring that has hitherto prevailed in Los Angeles and Ventura counties bears the same relation to well boring in Pennsylvania that a claim "hogged" on the Mexican principle has to the superbly developed mines on the Comstock lode. It is much to have learned that we have in this section reliable oil wells. Their development will be certain to follow in time, just as the development of every other capability of this section has surely taken place. And we think development has fairly set in now.

#### PIPES FOR GAS AND OTHER PURPOSES.

(Continued from SUPPLEMENT, No. 62.)

##### Mains.

The various joints in use for connecting gas main-pipes may be conveniently classed under six separate heads—viz., flange or flange, clip, collar, screw, spigot and faucet or socket, and ball and socket joints.

When flanged pipes (Fig. 4) are employed, a ring of felt, and sometimes of lead or iron, covered with yarn or flax, and smeared with red or white lead, is usually placed between the ends, and bolts are inserted through the holes cast in the flanges.

The bolts vary in number, being four, six, eight, or more, according to the size of the pipe, and range in diameter from one-fourth of an inch to seven-eighths of an inch. On



FIG. 4.

the nuts being screwed up, the two ends of the pipes are drawn together as closely as the intervening packing will allow.

The space left between the flanges, when a metallic ring has been interposed, is generally about one-fourth or three-eighths of an inch wide, which is filled in to the level of the rims of the flanges with iron or other cement.

When lead rings are used for jointing, they are best made of one-fourth or three-eighths inch piping, the ends being soldered together evenly, and the whole covered with flax, coated with red lead of the consistency of thick paint. The ring of lead pipe should not be beaten flat, but left in its round form, so that when the joint is screwed up the lead may bed into any irregularities in the surfaces of the flanges.

Sometimes a projection of the metal, about a quarter of an inch thick, is cast on the ends of the pipe, Fig. 5, and this, being truly faced in a lathe, admits of a tight joint

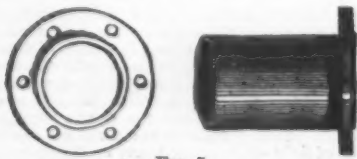


FIG. 5.

being made, without the interposition of a washer, by simply painting the two surfaces with white-lead paint, and drawing them together by means of the bolts, the intervening space being caulked with cement, as in the previous instance. Or the whole of the front surface of the flanges may be turned true, and the joint completed without the necessity of a cement packing. The faced joint, however, can only be employed when the line of pipes is perfectly straight. As a further precautionary measure against leakage, the bolts used for jointing flanges should have a gummet of flax or tow, smeared with red or white lead, placed round their neck, and under the washer at the nut end, to bed on the flanges when screwed up.

The common flange joint is but rarely adopted for gas-

mains. In the earliest days of gas lighting, when cast iron was first employed in the manufacture of pipes, this was the

FIG. 6.

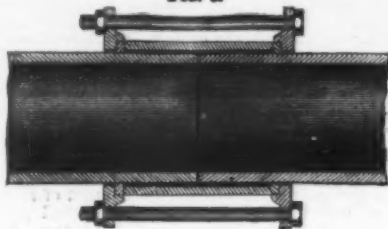
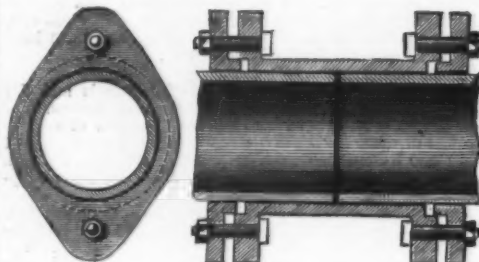


FIG. 7.



only joint in use; but it was soon found that numerous fractures occurred in the line of mains, owing to its rigid, unyielding character, no allowance having been made for the expansion and contraction of the metal due to changes of temperature. The extra labor and expense attending its use are also considerable. For steam-pipes its adoption is very general, and, of course, provision is made for the contraction and expansion, by the interposition of sliding-joints at proper intervals. When well made, and supplemented by some compensating arrangement to allow for the effects of temperature, there can be no question of its superiority over all other joints in tightness and durability.

Movable flange joints of different descriptions have been invented from time to time. In 1861, Dr. Normandy patented a mode of joining, as shown in Figs. 6 and 7. According to this method, the pipes to be connected are made plain from end to end, or, at any rate, at each edge of either end, and flanges, provided either with an annular recess or protruding rim, are slipped on to the pipes. Rings of vulcanized india-rubber, or other suitable packing material, are also slid over the ends, and then a short cylinder or thimble, made to fit loosely on the exterior diameter of the pipe, and having flanges cast on if thought desirable, is placed between the two rubber packings. Screw-bolts are introduced into the flanges, which, on being drawn together, form a tight joint.

Another plan of movable flanges and india-rubber rings is that of the "universal joint" of M. Marini (Fig. 8). It resembles the one just described, the difference consisting in the shorter length of the thimble, admitting of greater flexibility. In this case there are also two loose flanges, two

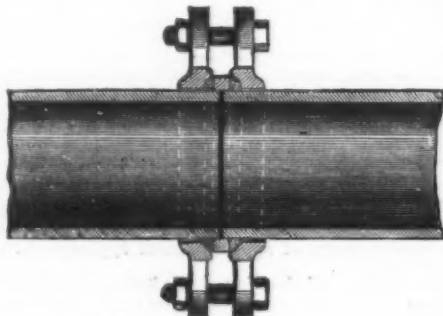


FIG. 8.

vulcanized caoutchouc rings, and a small cast iron band. The joint is made by putting on the end of each pipe the flange and the caoutchouc ring which belong to it, and then, over the end of one of the pipes, the cast iron band; the pipes are laid in line, and the collar is drawn over the point of junction. The caoutchouc rings are then placed at the opposite sides of the iron band, and they are pressed against it by means of screw-bolts through the flanges.

Petit and Lavril's joint is shown in Fig. 9. In this arrangement there are also two flanges, one being fixed and the

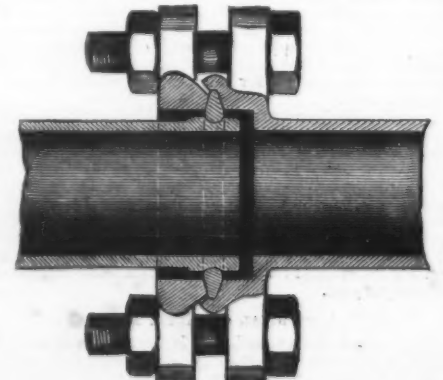


FIG. 9.

other movable. The ears of the flanges are placed horizontally in the trench for convenience in jointing. A ring of vulcanized india-rubber is placed within the groove made to receive it, and the end of the pipe carrying the loose

flange is introduced into the other pipe with the fixed flange, thus pressing the flexible ring to the bottom.

On the bolts being put in and screwed gradually up, the india-rubber ring is squeezed into the conical form shown.

The advantages claimed for these joints, with movable flanges, are economy, perfect soundness, and durability, ease and rapidity of application. They are asserted to be cheaper than the socket and spigot ordinarily in use, inasmuch as they save the gasket, the lead, and the fire necessary for melting it. By the two first described methods of jointing with the loose flanges, a pipe can be taken out and another substituted for it with great facility.

#### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, JANUARY, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the chair.

"On the Poisonous Properties of Yew Leaves," by James Bottomley, D.Sc.

In the *Field* for December 23d is a letter from Professor R. V. Tuson relative to the poisonous action of yew leaves on pheasants. At the end of his letter he promises to make an examination of the toxic properties of this tree, which up to the present time do not seem to have been fairly investigated. In November, 1871, a similar case came under my notice. A number of pheasants were found dead on the estate of Mr. Baring, in Hampshire. Four of the birds were sent to me for examination. Three of them contained in their craws considerable quantities of yew leaves along with grain. The craw of the fourth bird contained neither grain nor yew; there was only a little mucus, distended with bubbles of air. The yew had no doubt passed into the alimentary canal and could not be very distinctly recognized. In the course of the investigation I found that apart from botanical characteristics the yew could yield well marked chemical reactions. It became necessary to subject yew leaves to the same process as would be used to separate strychnine from animal tissue, the ethereal extract finally obtained having been evaporated to drive off the ether. There remained on the evaporating basin a thin varnish-like residue which was very bitter to the taste. When treated with cold nitric acid this residue assumed a dark blue color like indigo. Upon the application of heat the color disappeared.

"On the Luminous Sulphides of M. Ed. Becquerel," by William Thomson, F.R.S.E.

My object in bringing this communication before the Society is to show what I consider to be some most interesting substances, viz., the sulphides, principally of the alkaline earths, the luminous properties of which were studied many years ago by M. Edmond Becquerel and others. These samples which I have received some time ago when in Paris through my friend M. Auguste Guerout, Préparateur au Muséum d'Histoire Naturelle. They were prepared by M. André, the laboratory assistant of M. Ed. Becquerel, who has devoted much attention to the peculiarities of manipulation required to produce the greatest degree of luminosity in the sulphides after holding them for a few seconds before the sun's light, or a piece of burning magnesium wire or other source of light, and then placing them in the dark; doubtless many present will be familiar with the results arrived at by Becquerel and others, but a short résumé of some of them may not be out of place here.

When these sulphides, which must be kept in hermetically sealed tubes to prevent oxidation, are exposed to the rays at different parts of the spectrum, these rays have very different actions in rendering the sulphides luminous, and also in some cases of producing slightly different shades of color. The visible part of the spectrum has little or no power to render these bodies phosphorescent; the violet part, however, has greatest action, and the ultra-violet rays produce the maximum effect. M. Becquerel found, then, in these sulphides, an interesting method of examining the invisible parts of the spectrum, which furnished an addition to those employed, viz., the thermometer, silver compounds, etc.; these sulphides may be compared to chords which have the power of absorbing vibrations whose wave-lengths are too small to affect the organs of hearing—too shrill to be heard—and of changing them into vibrations of greater wave-lengths, and emitting them, so that they may be distinctly heard.

When these sulphides are held before some source of light, the sun's rays for instance, and then placed in a dark room, they gradually, after many hours, lose their phosphorescence—if, however, they be then heated a few degrees above the temperature at which they have remained, say from 60° to 80° F., they again become faintly luminous, and if kept for some time at that temperature they gradually lose their phosphorescence again; if allowed to cool in the dark to 60° F., and again heated to the same temperature, they show no phosphorescence; but if heated to a still higher degree of temperature, say 100° F., they again become luminous, and so on; this power may be regained and lost any number of times by placing them for a few seconds before any bright source of light and then removing them to a dark room—an electric current from a Ruhmkorff's coil passed through vacuum tubes containing these sulphides also develops their different colors.

The interesting point with respect to the sulphides which I show here this evening, is that they have been prepared by a special mode of manipulation by M. André, and that the luminosity or phosphorescence capable of being produced by them is greater than that from any which hitherto have been prepared.

The following gives the composition of the different sulphides which show the differently colored phosphorescences:

Green is composed of sulphide of calcium.

Orange is composed of sulphide of calcium which has been heated with 1 or 2 per cent. of binoxide of manganese.

The lime for the preparation of the above mentioned two colors was produced by the calcination of oyster shells.

An orange-colored phosphorescence is also produced by sulphide of barium.

Blue and violet are each sulphides of calcium which have been prepared from precipitated carbonate of lime.

Yellowish green is simply sulphide of strontium.

Yellow is sulphide of strontium which has been calcined with 4 or 5 per cent. of sulphide of antimony.

#### TO ELECTROTYPE INSECTS, FERNS, ETC.

IMMERSE the object in a solution of nitrate of silver in wood naphtha. When partially dried, the object should be treated with ammonia, the result being a double salt easily reduced. After thorough drying, expose the article to the vapor of mercury, when the surface becomes completely metallized in a few minutes. It may then be placed in the bath, and metal deposited in the usual way.—*Photo. News.*

# THE COLLODIO-BROMIDE EMULSION PROCESS APPLIED TO TRANSPARENCIES, AND ENLARGING WITHOUT A NITRATE BATH.

[A communication to the South London Photographic Society.]

By WILLIAM BROOKS.

## Stereoscopic Transparencies.

It is to be regretted that stereoscopic pictures are in so little demand at the present time; I allude both to the ordinary paper slide and the transparency on glass. The latter, to my mind, if properly made, is one of the most beautiful productions of the photographic art. I attribute the falling-off in the demand for the ordinary paper slide (to be viewed by reflected light) to the enormous amount of trashy stuff the market has been glutted with—looking abominable out of the stereoscope, and much worse in it.

The great drawback to the glass transparency, I think, has been its price—the best ones being made by a very tedious process on a film of albumen, which is liable to fade. I do not think that at the present time a good slide can be obtained at less than five shillings; and such a price is far too high for persons of limited means to purchase. A moderate collection (say fifty slides) at the price mentioned would come to a good round sum—more than many could afford—and therefore they go without them altogether. The great cry of photographers of the present day is for something new that would create a demand; now this branch of the art is one that has been but little worked, and the little that it has been worked has been done in a very expensive way. I think the generality of photographers are very conservative, and will not do anything unless it can be done with the nitrate bath, etc.; for if one happens to mention anything about emulsion work, dry plates, and the like, they begin to pull a long face and say they don't believe in it, and still go on in the old jog-trot sort of way.

I have tried the nitrate bath, iron development, and pyro. development for stereoscopic transparencies, and the results have always been cold and hard, with inky tones and very coarse. I can find nothing for their production like the emulsion process worked in the way I shall describe, showing you the results of my experiments. I am able to obtain all the warm tones exactly the same as we see in our well-toned silver prints—a nice, rich, warm, chocolate brown—rivaling those I before mentioned as produced on the albumen films; and they can be produced and retailed in the market at about two shillings and sixpence each, leaving a good margin for profit. If a good demand sprang up they could be reduced still lower in price, which, I am sure, would cause a revival of the stereoscope. At the present time there are thousands, and I may say, tens of thousands, of stereoscopic negatives now idle, stowed away in the plate-boxes of the photographer, both amateur and professional. There are several methods by which they can be produced.

No. 1.—Printing by contact is all very well if only one or two be required; but for commercial purposes it does not answer, as the negative becomes damaged in spite of every care that is taken in dusting both negative and plate, although contact printing produces very fine results. At the same time, to produce the subject in its proper position two glass plates have to be used besides the one that carries the collodion film, which has to be cut and the halves transposed to bring them into their proper position (presuming the original negative has been taken with a binocular camera). In printing by contact the glass used must be perfectly flat and clean. In this case the plate must be albumenized with—

White of..... 1 egg.  
Water..... 1 pint.

The plates can be either immersed in it or coated with it while still wet and set aside to dry. My reason for albumenizing the plates is that in contact printing, if the film gets punctured with small holes, it will sometimes crease up during development and spoil the plate. After the plate is thoroughly dry it is coated with a thin collodio-bromide emulsion, known as "washed emulsion," and set aside to dry, film outwards. I may also mention that it requires a little knack in coating the plate to avoid crapy lines. A pool of emulsion is poured on one end of the plate, allowed to flow downwards in a wave, and poured off at one corner, when the plate is rocked once or twice—not more; then bring the plate into a vertical position, and by this means, if the emulsion be in good condition, all crapy lines will be avoided.

After the plate is dry it is placed in contact with the negative in an ordinary printing-frame, and exposed to the light from one to three or four seconds, according to the density of the negative and intensity of the light. Care must be taken in removing the plate from the negative that it does not grate, as the film is very tender. Methylated spirit is now poured over the film and returned to the bottle, as in the case of collodion, and allowed to soak in for a minute or two. I do not hold with the plan of diluting the spirit, for if diluted it does not do its intended work so readily, and the development is more difficult; the film requires to be restored to its pasty condition as much as possible. If a quantity are being done, the best way is to use a dipping-bath with a cover.

On being removed, the plate may either be washed under a tap or immersed in a dish of water till all the greasy lines are removed and the water flows freely over its surface. The plate is then placed in a little shallow glass tray similar to that described by me in the *British Journal Photographic Almanac* for 1876, page 115. I find it very handy, and the progress of development can be readily seen without any fear of its falling out when holding it up to the light to look through it; it can be turned bottom up, yet sticks as tightly as wax.

I prepare stock solutions, which keep well in stoppered bottles, thus:

P.  
Pyrogallie acid (English).....96 grains.  
Absolute alcohol (sp. gr. 805°)..... 1 ounce.  
B.  
Bromide of potassium.....15 grains.  
Water..... 1 ounce.  
A.  
Liquor ammonia.....40 minims.  
Water..... 1 ounce.

After the plate has been sufficiently washed in a clean measure, take five to ten drops of solution P, three drops of solution B, one drop of A, half an ounce of water, and pour this over the plate. If properly exposed the image will begin to appear in about half a minute. The above quantity of developer is for stereo. size. If the image appear too quickly, add a drop or two more of solution B; if it come up slowly, add another drop of A. When the developer apparently ceases to act, add one or two drops at a time of each of solu-

tions A and B, which will give intensity. This system of development is the ordinary method adopted, but gives to transparencies a rather smoky color when viewed by transmitted light. I find that I am able to get very pleasing tones, similar to those we have in our well-toned silver prints. Instead of using plain water I use a solution of acetate of soda, which I keep as a stock solution:

Acetate of soda..... 4 drachms.  
Water..... 1 pint.

This not only seems to impart a better tone to the picture, but it also appears to act as an accelerator. I also use a solution of phosphate of soda if I wish to have a sepia tone. The phosphate solution is used in place of the acetate of soda solution, and in the same manner:

Phosphate of soda..... 2 drachms.  
Water..... 1 pint.

I will now pass for your inspection specimens developed by both methods, which will fully corroborate what I have just stated. I have no doubt that using other neutral salts will give a greater variety of tone. Should the tone appear a little too warm in color I give a slight intensification with:

Pyrogallie acid..... 3 grains.  
Citric acid.....14 grain.  
Water..... 1 ounce.

With a drop or two of a ten-grain solution of nitrate of silver, as in the wet process.

I must not omit to add that the alkaline developer should be well washed off, and some dilute acetic acid flowed over the plate to neutralize all traces of ammonia to avoid stains. If black tones are required give a much shorter exposure, and develop by either of the before-mentioned methods, not carrying the alkaline developer too far, but bring it up to the required density with the acid pyro.

Fix in a solution of:

Hypo..... 1½ ounce.  
Water..... 1 pint.

Well wash, and varnish with a varnish made of white, hard varnish thinned down to the proper consistency with methylated spirit, adding about two drops of castor oil to prevent its splitting in time to come.

Instead of using ground glass—a good sample adding very much to the cost—I use an ordinary matt varnish diluted with ether, as it gives a much finer grain, and is very inexpensive, which must not be lost sight of. The slide is now ready for mounting.

No. 2.—Instead of printing by contact use a non-distorting lens, and make the transparency in the camera in the ordinary way, using the plate in the dry state, as in the preceding method. The transparency also requires cutting for transposing. The best system, however, is to cut the negative in half and transpose. By copying with the camera, we also have the advantage of either reducing or enlarging the subject according to the amount of the subject to be included, and a mask put in the dark slide in front of the plate makes a much neater job. The development is the same as in printing by contact.

No. 3.—The plate is coated with emulsion; but, instead of letting it dry, put it in a dish of water until all greasiness has disappeared, and expose in the camera while still wet. No substratum must be used in this instance. By this method the tones are different, giving a greenish hue. When fixed, washed and dried, it is coated with a solution of india-rubber in benzole, and then with a thick collodion, alternately, several times, until a good thick film is obtained, similar to the Warnerke films. In the last coating of collodion I saturate it with white wax; this dispenses with the use of the ground glass or matt varnish. When perfectly dry the film will readily peel off; then it is cut and transposed, gummed at one edge of a cut mount, and bound between two pieces of glass. This system is more tedious than the former ones. I now pass round a slide made by this method.

Lantern Slides.—These can either be produced by contact, in the same way as the stereo, slides (and developed also in a similar manner), or they can be copied from the negative in the camera and enlarged or reduced at pleasure. At the last meeting of this Society, being the popular lantern evening, the whole of the slides I exhibited were made by this process. Most of you saw the kind of image they produced on the screen. Several members having wished to examine the slides themselves, I now take the opportunity of complying with their request. In making the slides, it is better that they should be developed by the alkaline developer alone; and, as it is an important point to keep the lights of the picture bare glass, before fixing flood the plate with:

Acetic acid (Beaufoy's)..... 2 ounces.  
Water..... 8 "

This appears to take up any deposit on the surface that may have taken place during the development. I have heard several complain that slides produced by this process looked cloudy. Varnish with diluted white hard spirit varnish, the same as mentioned in a former part of this paper.

Transparencies for Decorations.—These may be produced by the same process. I will leave you to judge of how far I have succeeded by the specimens I have brought with me. I find that frames can be purchased in brass with chains for suspending those for window decorations, which answer the purpose admirably.

Enlarging Without a Nitrate Bath.—If a negative be taken with the intention of producing an enlarged negative I prefer taking the original on one of the dry plates before mentioned, using only alkaline development. If acid pyro. and silver be used, it causes a granular deposit. It is true that granules are small; but when enlarged up to several diameters they are very offensive, as we all know. If the negative is to be printed from, and not enlarged, I quite agree with Mr. Woodbury that it is best to intensify with pyro. and silver; the resulting print will have a true dry-plate effect. The effect of this pyro. and silver intensification is that it produces a very fine stipple which gives softness, but will not do for enlargement, and I think this is why enlargements look coarse.

I prefer to make the transparency by contact and develop by the alkaline method only. The enlarged negative is made in the ordinary way from the transparency, instead of using a plate prepared in the bath. The plate is coated with an emulsion, and immersed in water until the water flows freely over its surface; it is then ready for exposure. I have prepared an enlargement by this method, using alkaline development, followed by pyro. and silver, to bring up the intensity. I have brought with me the transparency and enlarged negative, also some prints from the latter. You will find there is not any coarseness, although I have enlarged it up to three and a half diameters, and I now submit it for your inspection.

# HOW TO ASCERTAIN THE STRENGTH OF A SILVER BATH.

PREMISING that, after a negative bath has been in use a short time, it is impossible to estimate with any degree of accuracy the proportion of silver contained in it by means of the hydrometer or argentometer, owing to the formation of other salts by the immersion of the collodionized plate, other methods of determining its strength by volumetric processes have been devised to insure accuracy. The latest of these has been published in *La Moniteur de la Photographie*, by M. Boivin, which possesses, at any rate, the merit of simplicity.

Into a vial graduated in cubic centimetres—say 0 to 25—M. Boivin introduces at zero the requisite quantities of the following liquids:

Distilled water.....1,000 c. c.  
Dry chloride of sodium..... 6 gr. 9  
Bichromate of potash..... 1

In a test tube he pours about two cubic centimetres of the bath to be analyzed, and of this adds, drop by drop, enough to the solution in the graduated vessel to effect a certain change.

The deep-colored precipitate at first formed turns gradually to white by the further addition of the silver. As soon as this result has been attained, by reference to the graduated scale on the bottle, the precise quantity of the silver solution that has been employed to effect the change will be noted. The figure observed gives exactly the weight of nitrate of silver contained in ten cubic centimetres of the bath submitted for analysis.

It is preferable to use this means for ascertaining the strength of nitrate of silver baths that have been used, as this method gives exactly the weight of the nitrate of silver, because baths, while working, become charged with various salts.

## POCKET PHOTOMETERS.

A NEW pocket photometer has lately been described to the French Society of Photography by M. Schutte. The instrument has exteriorly the form of a small telescope. Putting your eye to the narrow end, and looking through at a luminous source, you see a small, luminous circle, on which it detached some figure in black. On turning the wider part of the instrument, the more you advance in the series of numbers the weaker is the light perceived; and, at length, it quite disappears. This effect is obtained by means of leaves of waxed paper, the number of which increases with the figures. Thus, it will be understood that a weak, luminous source does not allow one to see the same number as a strong one, and the variation between the figures is greater the more difference there is in intensity. Thus one may be enabled to determine the proper time of exposure.

# PREPARATION OF THE EARTHY METALS IN THE CHEMICAL WORKS OF DR. SCHUCHARDT AT GORLITZ.

By E. FREY.

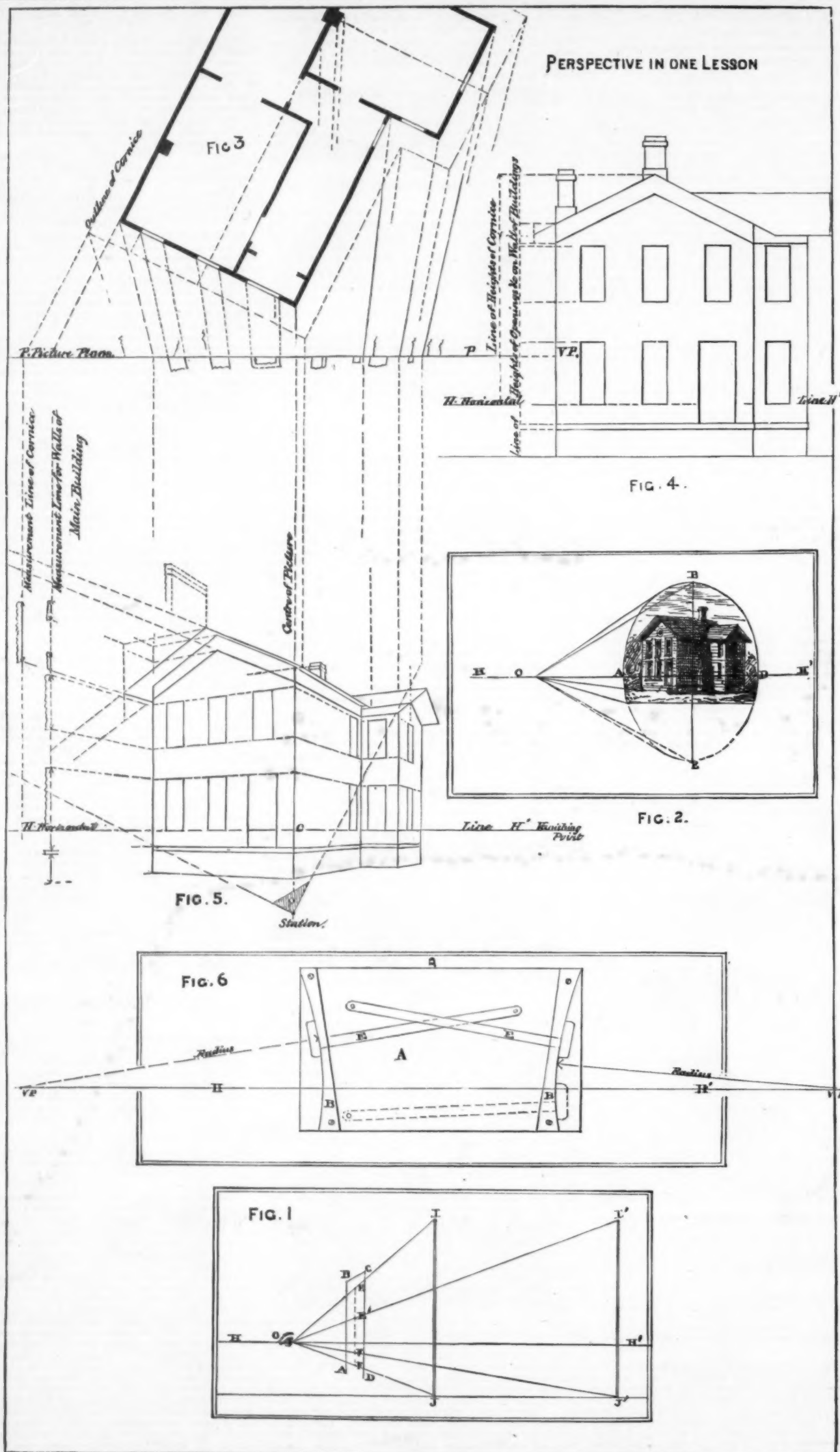
CALCIUM, strontium, lithium, and cerium are prepared in quantity in this establishment by Bunsen's electrolytic process. A current of 60° is found more serviceable than one of 90°, as originally recommended by Bunsen. Calcium is not of a brassy yellow, but exactly resembles aluminium in appearance. It is brittle, and cannot be laminated or drawn out to wire. Strontium is a pale brassy-yellow metal, very pliable, and capable of being rolled and drawn, but it oxidizes more readily than calcium. Barium has not yet been obtained by this process in a compact state, owing to its elevated melting point, which appears to be higher than that of cast iron. From the amalgam the metal was obtained not in a fused, but in a fritted state, in masses exceeding 100 grms. in weight. This was effected by distilling off the mercury in a wrought-iron retort, fitted with a ground lid, into which two iron tubes were screwed. The retort, coated with clay, was exposed to the most intense heat, whilst a continuous current of dry hydrogen was passed through it. Small globules of lithium were fused in an iron capsule to masses of nearly 2 grms. in weight. Cerium prepared by the electrolytic process has all the properties described by Wehler in 1867. It is particularly distinguished by its brilliant and explosive combustion.

## TIN AND PHOSPHORUS IN COPPER.

By M. HAMPE.

ACCORDING to Karsten, an addition of 0.3 per cent. of tin does not affect the tenacity of copper when cold, but renders it brittle when hot. The experiments of the author prove that the presence of tin in the proportion of 0.1 to 1 per cent. is without marked influence upon the ductility of copper, whether cold or hot. Alloys rich in tin have a tendency to assume a crystalline texture; nevertheless, their malleability is not much affected if the first hammering is conducted with caution.

It is to be remarked that in refining copper there is produced a disengagement of gas (carbonic oxide, hydrogen, carburetted hydrogen) during the operation of "poling;" and that a portion of these gases are retained by the copper after its complete reduction, rendering it porous and diminishing its malleability in the cold. This inconvenience is partly remedied by not removing all the oxygen from the copper. But the porosity of the copper may be more completely avoided by not producing absorbable gases during the process of refining. The use of phosphorus completely attains this object. Phosphorus removes all the oxygen without evolution of gases, and the presence of a slight excess of phosphorus in the copper has no injurious influence. Copper thus refined is perfectly homogeneous, and with a fracture not granular like that of ordinary refined copper, but full, and often fibrous. If phosphorus is thrown upon melted copper, there is produced a lively agitation, which remains for some time after the phosphorus has disappeared; on cooling there is formed a slight layer of dross, which is easily detached from the metal. The density of copper refined with phosphorus is 8.924; that of copper refined in the ordinary manner is 8.931 to 8.960. The phosphoric copper is more tenacious and ductile, though its degree of ductility is not very constant, a circumstance due to the fact that a more or less considerable part of the phosphorus which has been added burns without utility on the surface of the melted metal. The addition of phosphide of copper, in place of free phosphorus, would certainly give better results.—*Berg und Hütten Zeitung.*



## PERSPECTIVE IN ONE LESSON.

By HENRY F. LIEBE.

## THE DIMINUTION OF OBJECTS.

THE student having often observed that all objects in nature appear to diminish, and that in proportion to the distance that intervenes, will naturally ask as to the cause.

This I will try to explain, in a very tangible way, by Fig. 1, where we will suppose J I to be a rod, or any other object, 20 feet high, set in vertical position, at a distance of about 16 feet from the eye of the spectator O, A B C D being a transparent plane intercepting the rays of light from the top and bottom ends of the rod in E and F. Now, imagine the same rod moved backward, say 24 feet, and the rays of light from the same ends of the object intercept in E' and F'. The space between E' and F' being much less than from E to F. Now, what is true in this condition must also be true if the rod were rotated on its axis or horizontal line, and thus form a complete cone of rays.

What is true of the interception of the rays of light on the plane A B C D is almost identical with that of the eye. The plane A B C D is called the "picture plane," and is the surface on which we draw.

We find, then, that the size of an object depends on the more or less openness of the angle J O I, which is called the "visual angle," which, being wholly dependent on the relative position of spectator and object, brings us to the consideration of the

## STATION.

The station, or point of sight, is the eye of the spectator—of importance, principally, in relation to the vanishing points.

Objects are seen differently by different persons, though the view be taken from the same station, owing to the deviating and peculiar formation of our eyes; but, in general, we should stand far enough away from an object so that the visual angle is not greater than 60°. What I mean by this, I will try to illustrate by Fig. 2, where we will suppose the eye of the spectator to be at O—sufficiently distant from the object so that the rays of light from the base of the cone, A B D E, form angles with its sides of 60°—base and sides forming an equilateral triangle.

As a guide for choosing distances productive of the most pleasing result, I would advise the student to make some practical observations, and note the distances—which he can do by counting the number of steps that were necessary to reach the object.

## HORIZONTAL LINE.

This is a line running horizontally on the object viewed, on a level with the eye of the spectator, and is of practical importance, because it is on this line that the vanishing points are to be sought.

Supposing the student to be stationed on level ground, viewing a building in perspective, he will notice that the direction of the horizontal lines, formed by the cornices, belts, etc., above the eye, tend downward, while all similar lines below the level of the eye have an upward tendency, as they recede from him; while on a level with the eye there is a line running horizontally, cutting everything he views. Now, let him suppose the lines above and below the horizontal line to be indefinitely produced in the direction they seem to take, and he will perceive that they must intersect somewhere, and that, too, on the horizontal line, therefore, the vanishing points for all lines lying parallel to those forming the intersection.

The altitude of the horizontal line will, of course, depend on the relative positions of spectator and object; being either above or below, or reflected against the object viewed.

The center of pictures is directly in front of the eye, on the horizontal line, and is the centre of the cone of the rays of light that the eye perceives—as C, Fig. 2.

## OF THE VANISHING POINTS.

The vanishing points, as before stated, are to be sought on the horizontal line, and at the intersection of the lines lying parallel to that line.

So now, all that remains is to find at what distance from the center of pictures such intersection occurs, and then the student will be quite ready for a practical experiment.

The distance of the vanishing points from the center of the picture is entirely dependent on the station. So, after having determined on that, draw lines through the station, parallel with the sides of the building (plan), and at their intersection with the picture plane will give the points sought.

The above applies to all possible shapes of buildings (ground plan), except curved or circular; but for the horizontal lines only, for lines inclined at an angle to the horizontal plane—as gables, pediments, etc., the vanishing points will be found above and below the horizontal line, and in a way that will be best shown in our lesson, which will be a practical application of all the foregoing, and is now in order.

Let Fig. 3 be a ground plan, and Fig. 4 an elevation of what, in our perspective, will form the guiding lines.

First, take the ground plan and draw the projections of the cornice, then place it on the board in just such position as you wish to see the building in nature, as at Fig. 3; this done, determine the station, say 65 feet, from the foremost part of the building.

Now, draw lines from the station to the extreme angles of the building; also draw the center line, S. C. We are now ready to draw the picture plane, which, as the student will see, can be placed anywhere between the station and the building, just according to the size of the picture he may wish, in this case almost as large as possible, as P P' at right angles to S. C.

Next, we must determine the vanishing points, which we do by drawing lines from the station to the right and left, parallel with the sides of the building, and at their intersections with P P', will give the points sought—the one at our right is on our sheet, but the one at the left lies beyond its border.

(In performing the above operations the student had better cover up Fig. 5, or imagine it does not exist, for, in practice, no immediate connection of ground plan and perspective is made, but here so shown to make it the better understood.)

Having drawn P P' with one end of our straight edge, or T, fixed at S, continue to draw lines from all the angles of the building, openings, all points of cornice, chimneys, etc., to the picture plane, giving to each some sign indicative of its source.

Referring now to Fig. 5, draw H H', drop perpendiculars from the vanishing points on P P', cutting H H', at these points fix pins against which we can work our T; then draw

perpendiculars from all the points on P P', continuing them down below H H' a short distance.

It now only remains to apply the heights, and the student will readily perceive the whole method of drawing the perspective.

Fig. 4, representing the elevation—first, draw the horizontal line at such height as it will be in nature, in this case, say 6 feet above the ground line; draw the lines at the left, that I have marked lines of measurement; on these mark all the heights as shown, being careful not to forget H H'.

Returning now to Fig. 3, draw lines from any of the surfaces of the building, as at the left, cutting P P', and from these drop perpendiculars, and on these apply the heights as taken from the elevation by means of a strip of paper, making all the measurements above and below the horizontal line.

Now, with the T against V P at the right, carry all the points to the angle of the building, and from thence draw lines across the several faces, by using the V P' alternately; in a similar manner obtain the lines of the cornice and lower line of frieze.

To obtain the V P' for the lines of the gables, extend the lines indefinitely, as shown, until they meet, which will give the points sought, and gives use to the following rule: The vanishing points for all lines inclined to the horizontal lines at an angle can always be found by the use of a parallel line, lying at some distance from the given line, either in the vertical or horizontal plane.

I have purposely chosen a simple object to illustrate the system of drawing, and have shown, by dotted lines, the whole connection of ground plan with picture, application of vertical measurements, etc., so that I am confident that the student will have no difficulty in comprehending the whole.

Before attempting a finished perspective, I would advise him to make similar exercises, using some plain design, and drawing only the outlines, so that he may become perfectly familiar with the whole process, after which he can introduce details.

In practice, no unnecessary lines should be drawn in the picture. Take the ground plan, lay off all the projections, such as balconies, hoods, brackets, and outline of cornices, etc., then fasten it on a board or table, and perform all the operations shown at Fig. 3, and transfer all the points from P P', with a strip of paper, to the paper prepared for the drawing.

Finishing up a perspective in detail will, of course, tax the ability of the operator, and the degree of success depends on experience and practice.

Shades and shadows, although forming a very important part of a picture, I shall not discuss, referring the student to technical works on the subject; but, in all small drawings, the draftsman who has thus far mastered the subject will be able to supply them sufficiently correct to give all desired artistic effect.

## LINEALS.

Those who have had some experience in perspective drawing will have often found that V P's lay beyond the limit of the drawing board. Fig. 6 illustrates a method of overcoming this difficulty. E E being two T squares, very light and thin, with the front edge set exactly in the center of the head block, B B, two pieces of wood,  $\frac{1}{4}$  in. thick, fastened to the end of the board, with the segments sawed out, and the T's worked as shown. The method of obtaining the curve is, I believe, sufficiently illustrated in the diagram. I prefer this method in preference to any other kind of lineals.

I ought, perhaps, to consider the perspective of circles and polygons, but as I have already occupied too much of your space, I shall leave their solution to the ingenuity of the draftsman, who, having learned to put points into perspective positions, will find but little difficulty in his way.

—American Builder.

Des Moines, Ia.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN, JANUARY 15, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the chair.

The Council reported that the decennial anniversary of the Society would be observed by the issuing of a complete index to the *Berichte* for the first ten years.

Prof. C. Liebermann stated that, in connection with Dr. Benzinger, he had obtained a "Mono-nitro-thymol" which yielded, through the amido-compound, thymo-quinon, and gave an experimental proof that the quinon group is formed from an hydroxyl group and a nitro group of dinitro-thymol.

F. Tiemann and N. Nagel described "Homo-Vanillic Acid and Homo-Protocatechuic Acid." The former,  $C_{11}H_{10}O_4$ , was obtained along with vanillic acid, by the oxidation of a solution of acet-eugenol in acetic acid with potassium permanganate. It possesses a much greater solubility in water than vanillic acid, but otherwise has nearly the same properties. Treatment with hydrochloric acid yields  $CH_2Cl$  and homo-protocatechuic acid,  $C_8H_6(OH)_2CH_2COOH$ . This acid is more stable and soluble than protocatechuic acid, gives also much brighter color reactions with a ferric solution, and by distillation of the calcium salt yields homo-pyrocatechin.

F. Tiemann and A. Herzfeld read a paper "On the Formation of Para-Cumamic Acid," which was obtained from para-oxyl-benzaldehyde.

H. Vogel described "The Spectroscopic Reactions of Purpurin." A solution of perfectly pure purpurin gives two prominent bands between D and E, and between B and F. The spectrum disappears at once upon the addition of a trace of lime. It was found that the presence of 0.000003 grm. of CaO in a litre of the solution was sufficient to cause this change. No effect was produced by the addition of BaO or SrO.

The Secretary read the following communications from non-resident members:

S. Bogusky and N. Kajander, "Rapidity of the Evolution of Carbonic Acid." Experiments were performed with Carrara marble and five acids— $HNO_3$ ,  $HBr$ ,  $HCl$ ,  $CH_3CO_2$ , and  $C_2H_3O_2$ . The first three appeared to obey a fixed law, that the quantities of carbonic acid evolved in a unit of time are inversely proportional to the molecular weights of the acids. Formic acid and acetic acid did not show this regularity, apparently in consequence of a physical change in the surface of the marble.

A. Christomanos, "On the Analysis of Chrome-Iron Ore." The author recommends a calcination of the roughly powdered ore before the final pulverization, and suggests some changes in the method of carrying out the analysis.

A. Basarow, "On a Lecture-Experiment illustrating the Explosive Character of Certain Substances."

F. Frehrichs, "A New Method of Organic Analysis." The essential features consist in combustion with oxide of mercury, absorption of the water by phosphoric anhydride, and use of the air-pump.

A. Ladenburg, "On the Constitutional Formula of Oxy-thymo-quinon."

A. Ladenburg and O. Struve, "On the Quantivalence of Nitrogen." The authors defend the trivalence of this element from the comparison of the two compounds  $N(C_2H_5)_3$ ,  $C_2H_5I$  and  $N(C_2H_5)_2(C_2H_5)C_2H_5I$ .

R. Anschütz and G. Schultz, "On Phenanthren." The authors give directions for the preparation of phenanthren and its quinon. By the action of  $NH_3$  upon the latter, the compound  $C_{14}H_8NO + H_2O$  was obtained.

H. Saubertlich, "On the Action of Sulphuric Acid upon Tri-oxy-benzoic Acid and Benzoic Acid." The result is a quinon,  $C_{14}H_8O_6$ , forming crystals with a metallic lustre.

A. Benuthsen, "On Sulphacetamid." Colorless crystals obtained by the action of sulphuretted hydrogen on acetonitrile, melting at 108°. Prof. Hofmann called attention to the fact that numerous investigations had sought in vain to obtain this compound.

The following communications were received by the Secretary before the close of December, and appear in the *Berichte* for 1876.

E. Elsasser, "On Electrolytic Action with Evolution of Hydrogen at Both Poles." This occurs when a platinum-magnesium element is immersed in very dilute sulphuric acid, or when the two metals in a solution of  $MgSO_4$  serve as poles for a battery, the magnesium forming the anode. In both cases exactly half as much hydrogen is liberated on the anode as on the cathode.

C. Böttiger, "On the Acids possessing the Formula  $C_6H_4O_6$ ." These three acids—citric, ita, and meta-conic acids—all yield, by reduction with zinc dust, ordinary pyro-tartaric acid, its-conic acid showing the most resistance to the reaction. Citra-conic acid was obtained as a by-product in the preparation of pyro-tartaric acid from pyro-mecmic acid.

A. Lauberheimer, "On Ortho-dinitro Compounds." The author shows that the dinitro-chloro-benzene previously obtained by him is a meta-para compound in regard to the Cl atom, by changing it into chloro-nitraniline. His experiments would also prove that all ortho-dinitro compounds yield sodium-nitrite and a phenol by treatment with sodium hydrate, and ammonium-nitrite with the corresponding amido by treatment with alcoholic ammonia.

E. Glatzel, "Some New Compounds of Titanium, and Experiments on the Solution of the Metal in Acids." Solution of the metal in  $HCl$  gave  $TiCl_3 + 8H_2O$ ; in  $H_2SO_4$ , the corresponding sulphate,  $Ti_2(SO_4)_3 + 8H_2O$ , laminated crystals yielding bright blue solutions. Nitric acid changes this sulphate into  $Ti_2(SO_4)_3 + H_2O$ —a yellow, resinous, exceedingly hygroscopic body. Titanium fluoride,  $TiF_4$ , was obtained by solution in hydrofluoric acid, but always in company with small amounts of  $TiO_2$ . The reactions of  $Ti_2(SO_4)_3$  with solvents are so similar to those of the so-called titanate of iron that the author regards this mineral as consisting of isomorphous mixtures of  $Ti_2O_3$  and  $Fe_2O_3$ . In the dioxide compounds Ti stands between Sn and Si; in the sesquioxide compounds it belongs to the group of Fe, Al, Mn, and Cr, showing the most resemblance to iron.

E. Erlenmeyer, "Extraction of the so-called Soluble Phosphoric Acid from Superphosphates." The author finds that acid phosphate of lime,  $CaH_2(PO_4)_2 + H_2O$ , requires 700 parts of water for perfect solution, and that with a smaller amount of water a certain quantity of the salt is changed into free phosphoric acid, and insoluble  $CaHPO_4 + (H_2O)_2$ . Möser's process of extracting the phosphoric acid on the filter is therefore only to be used with superphosphates containing sufficient free acid to prevent this decomposition; otherwise as much as 8 per cent. of the acid present passes over into the insoluble salt. Superphosphates containing no free acid yield correct results if digested with an amount of water at least 700 times the weight of the acid phosphate present.

"A Simple Preparation of Alkaline Cyanides." Fusion of sodium with anhydrous ferrocyanide of potassium yields a colorless fluid mass, easily poured off from the metallic iron, and becoming snow white on congelation. It contains 40 per cent. of cyanogen in combination with the alkaline metals.

$C_{12}N_4Fe_3K_4 + Na_2(CyK)_2 + (CyNa)_2 + Fe$ . "Preparation of Normal Valerianic Acid from Normal Caproic Acid." The latter is changed by Br into a bromo-caproic acid, then treated with  $H_2SO_4$ , oxidized with a solution of chromic acid, and finally distilled. The distillate contains valerianic acid.

E. Fischer, "Aromatic Hydrazin Compounds." Diphenyl-nitrosamine yields by reduction diphenyl-hydrazin,  $(C_6H_5)_2N - NH_2$ . It is isomeric with hydrazo-benzene, but the reactions of the two are strikingly unlike.

F. von Lepel, "Spectral Analytical Reactions for Salts of Magnesia." The presence of magnesia salts in solution modifies so characteristically the absorption bands in the spectrum of purpurin that a solution of the latter can be used to detect the presence of a fraction of a milligram. of a magnesia compound, even in company with the salts of the alkalies and alkaline earths.

H. Limpricht, "Action of Bromine on the Silver Salts of Benzoic Sulphonic Acids."  $C_6H_5SO_3Ag$  gives, with bromine, meta-bromo-benzene-sulphonic acid. The silver salts of ortho-, meta-, and para-bromo-benzene-sulphonic acid, give with the same treatment various dibromo-sulphonic acids, from which tribromo-benzene-sulphonic acid is obtained by the same process. Nitro-benzene-sulphonic acid yields no results. The amido-benzene-sulphonic acids show a variety of complicated decompositions. On account of the properties, salts, and reactions of nitro-meta-bromo-benzene, sulphonic acid follows:

I. Remsen, "On Phosphoric Oxichloride." This is easily produced by the action of ozone on the trichloride.

H. Beckurts and R. Otto, "On a Dichloro-Propionic Acid." This acid,  $CH_2Cl.CCl_2COOH$ , is obtained from a  $\alpha$ -dichloro-propionitrile by treatment with  $H_2SO_4$ ; boils at 190°; gives, with reducing agents, propionic acid; and with  $Ag_2O$ , acetate and carb-acet-oxylate of silver.

J. H. van't Hoff, "On Benzine Formula." Kekulé's hexagonal formula is defended against the proposed prism of Ladenburg.

H. Schröder, "On a Surprising Regularity in the Volume Relations of Certain Series of Compounds." The author has found, from numerous experiments, that the specific volumes of the various members of a series of compounds almost invariably stand in simple arithmetical relations to the specific volume of the common element or component, which not only imparts to the series its characteristic chemical behavior, but also exerts a dominant influence on the volumes of the different compounds. For example, Ag possesses the sp. vol. 10.28;  $Ag_2O$  gives 30.8 =  $3 \times 10.28$ ;  $Ag_2I$  gives 82.2 =  $8 \times 10.28$ ;  $C_2H_3O_2Ag$  gives 51.4 =  $5 \times 10.28$ ; pyrragryte,  $Ag_2S + Sb_2S_3$ , gives 185 =  $18 \times 10.28$ . Si possesses the sp.

vol. 11 3; quartz,  $\text{SiO}_2$ , gives  $22.6 = 2 \times 11.3$ ; diathene,  $\text{Al}_2\text{O}_3$ , gives  $45.3 = 4 \times 11.3$ ; etc.

H. Klinger, "On Thialdehyds." The author corrects erroneous statements with regard to the formation of thialdehyd, and describes a third isomeric, thio-benzaldehyd, obtained from benzole aldehyd by the action of  $\text{SH}_2$ .

E. Berglund, "Amido-sulphonic Acid." The author obtains it in the form of the Ba salt, by boiling barium imido-sulphonate with water and boric hydrate:  $\text{R}_2\text{O}_2(\text{SO}_2)_2\text{NH} + \text{H}_2\text{O} = \text{R}_2\text{O}_2\text{SO}_2 + \text{H}_2\text{N.O.SO}_2\text{OH}$ .

A. Aronheim, "Action of Stannic Chloride upon Benzene." The vapors of the two bodies passed through a heated tube give  $\text{SnCl}_4$ ,  $\text{HCl}$ , and  $(\text{C}_6\text{H}_5)_2$ , with no traces of an organic compound of tin. The process can be used for the preparation of diphenyl.

W. Michler and C. Dupertius, "Synthesis of the Ketones derived from Dimethyl-aniline." Dimethyl-aniline, upon treatment with  $\text{COCl}_2$ , yields, according to the temperature, hexamethyl-triamido-dibenzoyl-benzene, and tetramethyl-diamido-benzophenon. The latter is reduced with sodium-amalgam to the corresponding benzhydrol, the perfectly colorless crystals of which possess the remarkable property of imparting an intense blue to colorless solvents—as ether, alcohol, and acetic acid. Benzoyl-chloride and dimethyl-aniline yield dimethyl-amido-dibenzoyl-benzene, large well formed crystals melting at  $55^\circ$ .

E. Mulder, "On  $\beta$ -Amido-propionic Acid and  $\beta$ -Guano-propionic Acid." Improvements on the method of preparing  $\beta$ -amido-propionic acid from glycerin, and theoretical considerations with regard to the formula of  $\beta$ -guano-propionic acid.

H. W. Vogel, "Methods for Detecting the Adulteration of Wines." The author compares the methods at present in use, and proposes the use of the spectroscope for this purpose, adding the results of a variety of experiments. The presence of fuchsine is shown by its characteristic absorption band between D and E. *Ligustrum vulgare* gives bands at D and F. The coloring matter of mallow leaves is also easily detected in the same way.

W. Michler and A. Gradmann, "Synthesis of Organic Acids and Ketones by means of Carbonyl-Chloride." Diethyl-aniline gives, by treatment with  $\text{COCl}_2$ , diethyl-amido-benzoic acid,  $(\text{C}_2\text{H}_5)_2\text{N.C}_6\text{H}_4\text{COOH}$ ; and the chloride of this acid, by further treatment with diethyl-aniline, yields hexo-ethyl-triamido-dibenzoyl-benzene, and tetra-ethyl-diamido-benzophenon.

A. Claus, "On Melamine Sulpho-Cyanate." This compound,  $\text{C}_3\text{H}_3\text{H}_4\text{CNSH}$ , is obtained by heating  $\text{NH}_4\text{CNSH}$  at  $250^\circ$ ; prismatic yellow crystals.

"On a New Method of Preparing Stearic Acid." Ricinoleic acid,  $\text{C}_{18}\text{H}_{34}\text{O}_2$ , gives, with  $\text{HI}$  *in statu nascenti*, iodo-stearic acid,  $\text{C}_{18}\text{H}_{33}\text{IO}_2$ , a yellowish oil, and this upon reduction with zinc yields stearic acid.

O. Doebner and W. Stackmann, "Action of Benzo-Tri-chloride on Phenol." The result is benzoyl-phenol,  $\text{C}_6\text{H}_5\text{CO.C}_6\text{H}_4\text{OH}$ , analogous to the synthesis of salicylic aldehyd with  $\text{CHCl}_3$ .

H. Landolt describes the details of his arrangements for illustrating, by means of the magic lantern, various chemical reactions, such as the development of colored vapors, liquefaction of gases, sublimation, crystallization, etc.

S. Stein advocates the use of rock crystal for scale-beams, thermometers, normal weights, and measures of length.

W. Thörner describes a simple apparatus for fractional distillation in a partial vacuum.

C. Bulk describes an alteration in the construction of the ordinary filter pump, by means of which the water power can be used to produce also a forcible stream of air, and gives an account of a new separatory funnel more easily regulated than those at present in use.—*Chemical News*.

#### CHEMICAL SOCIETY, LONDON, JANUARY 18, 1877.

Professor ODLING, F.R.S., Vice-President, in the chair.

The first paper, by Dr. E. Jäger, "On some Derivatives of Dithymyl-trichlorethane," was read by the Secretary.

The next paper, "A Preliminary Account of some New Reactions in Organic Chemistry and their Ultimate Bearings," by Mr. C. T. Kingzett and Dr. H. W. Hake, was read by the former. After referring to the color reaction known as the "Pettenkofer reaction," produced by the action of strong sulphuric acid on a mixture of sugar and cholic acid and some other substances, as glycocholic, hyocholic, oleic, and lithofolic acids, etc., and various compounds occurring in brain substance, the authors state that they have found that many other bodies behave in a similar manner, as benzene, phenol, turpentine, camphor, salicylic acid, pyrogallol, piperin, morphine, clove, and other essential oils, and various fatty bodies. Camphor dissolves in concentrated sulphuric acid, forming a deep red solution, and this, when mixed with cane-sugar syrup, solidifies to a rose-colored paste; but, on adding water, the color is destroyed, and an almost colorless precipitate produced, which is soluble in ether. When treated with sulphuric acid, it now gives the color reaction without the addition of sugar, although, even when boiled for several hours with dilute sulphuric acid, no sugar could be detected in the solution; so that this substance differs in a marked manner from the ordinary glucosides. From a comparison of the reactions yielded with the Pettenkofer test by benzene, benzoic acid, and phenol on the one hand, and turpentine, camphoric acid, and camphor on the other, the authors are of opinion that camphor stands in a somewhat similar relation to turpentine that phenol does to benzene; that camphor, indeed, may be the phenol of turpentine and not a ketone as ordinarily supposed. The authors concluded with some observations on the ultimate bearings of these new reactions, which they consider to cover a very wide field; leading, for instance, to the question of the general constitution of sugars and similar problems. Some of the reactions mentioned in the paper were exhibited.

Dr. Odling having thanked the authors for their interesting paper, Mr. C. E. Groves asked whether they considered the new compound obtained with the camphor solution and sugar to be of the nature of a glucoside, and whether the cane-sugar which they employed was converted into glucose during the reaction.

Mr. Kingzett replied that from the difference observed when such bodies as mannite were substituted for sugar in the reaction, he considered it probable that glucose might be formed. The compound, however, was not an ordinary glucoside or saccharide, as it was not decomposed by boiling with dilute acids; he believed, however, it would prove to be of the nature of a substitution derivative of a hexatomic alcohol,  $\text{C}_6\text{H}_2(\text{OH})_6$ , in which one or more OH groups were replaced.

Dr. Armstrong said they were much indebted to the authors for bringing before their notice these interesting color reactions, but he thought the facts adduced as yet did not justify the speculative conclusions which they had drawn, as, for instance, that the relation between camphor and turpentine was similar to that between phenol and benzene.

Mr. Kingzett replied that, although he had not done so, he could give structural formulae to illustrate his meaning, and proceeded to show how some of the brain substances were split up under the action of sulphuric acid when they have this color reaction. With regard to the relation between turpentine and camphor, he considered there was strong evidence to prove that camphor was a phenol, and comparatively little to show that it was a ketone. The relation was brought out distinctly on comparing the formula—

Benzene,  $\text{C}_6\text{H}_6$  Turpentine,  $\text{CH}_3\text{C}_6\text{H}_4\text{C}_6\text{H}_5$   
Phenol,  $\text{C}_6\text{H}_5\text{OH}$  Camphor,  $\text{CH}_3\text{C}_6\text{H}_4\text{C}_6\text{H}_4\text{OH}$

Dr. Wright remarked that, although one argument in favor of the hydroxyl nature of camphor was its behavior with such reagents as zinc chloride and phosphorus pentasulphide, giving rise to cymene, yet, on the other hand, with phosphorus pentachloride it yielded dichlorinated derivatives, which was not in accordance with the ordinary behavior of alcohols under similar circumstances.

The next paper, on "Dinitroso-ornitin and Dinitro-ornitin," by Dr. J. Stenhouse, F.R.S., and Mr. C. E. Groves, was read by the latter.

The Secretary read a paper, by Dr. T. Carnelley, "On High Melting Points, with Special Reference to those of Metallic Salts, Part III." The author has determined the "time values" of nine standard salts by comparing the time of melting with that of sulphur; the times of melting of the different salts always bearing a constant ratio to one another and to sulphur, and this ratio is the time value for each given salt. By interpolation the author has constructed a table giving the melting points corresponding to various time values from 0 to 241.

#### CHEMICAL SOCIETY, LONDON, FEBRUARY, 1877.

Professor ABEL, F.R.S., President, in the chair.

The first paper was by Dr. H. E. Armstrong, "On Kekulé's and Ladenburg's Benzene Symbols." The speaker, after pointing out that although Kekulé's symbol had been used almost exclusively up to the present time, Ladenburg's "prism" formula merited more consideration than it had hitherto received, said that these two symbols were in accord in representing benzene as a symmetrical compound, i.e., in which the six hydrogen atoms were of equal value. This consideration was supported, not only by the fact that no isomeric mono-derivatives of benzene had ever been obtained, but also by direct experimental evidence; for whichever hydrogen atom in benzene is displaced by the group OH, we always obtain the same phenol, as shown in the decomposition of the different oxy-benzoic acids and similar reactions. With regard to the di-derivatives of benzene, there is no ground for supposing that more than three isomeric forms can exist, and in this respect, also, the two symbols are identical with regard to the number of such isomerides which they indicate. It has been urged that one of the chief reasons for the adoption of Kekulé's symbol is that the formation of additive compounds is readily explained on the supposition that, when a molecule of a halogen unites with benzene, two adjacent carbon atoms united by a double affinity each unite with an atom of halogen, and thus remain united to one another only by a single affinity. Ladenburg's prism formula, however, lends itself to a similar explanation, with this difference, that it is the opposite carbon atoms in the ring previously united by a single affinity which unite each with a single atom of halogen, and at the same time cease to be directly united. After some observations on the difficulty of explaining the nature of the quinones, and on the influence a group exercises on others occupying the ortho or para position relatively to it, which could not be satisfactorily accounted for by the use of Kekulé's symbol, whilst Ladenburg's prism formula offered a possible explanation, the speaker expressed his opinion that the term para as applied to the di-derivatives of benzene should be limited to those which were capable of yielding but a single tri-derivative, whilst those which gave rise to two and three isomeric tri-derivatives should be called ortho- and meta-derivatives respectively. This nomenclature, being founded on experiment, was independent of any theoretical considerations as to the so-called "position" of the substituted groups. At present, although all known facts are in accordance with the supposition that the six carbon atoms in benzene and its derivatives are united in a closed chain, we do not in the least know in what manner the atoms are united; for this reason the simple hexagon, now almost universally employed to represent benzene, was preferable to the graphic formula consisting of six Cs united in a hexagon by single and double lines alternately.

The President said they were all much indebted to Dr. Armstrong for the lucid manner in which he had discussed the relative value of the two graphic representations of benzene employed by Kekulé and by Ladenburg.

Dr. Odling said that it was the custom of the Society not to publish communications of a purely theoretical character, but he hoped that in this instance the Publication Committee might be induced to depart from the rule, so that they might have the benefit of perusing Dr. Armstrong's useful *résumé* in the Society's Journal. He quite agreed with the speaker that the evidence was overwhelming as to the existence of but a single mono-derivative of benzene of each kind; also in rejecting that form of expression for quinones which represented them as containing oxygen united with oxygen. It was in the highest degree improbable that this could be the case, considering how totally different they were from those bodies which, like the peroxides, were supposed to contain oxygen united with oxygen. With regard to the employment of the symbols 1:2:1:3, etc., he thought them preferable to the terms ortho, meta, and para, as these were employed in very different senses; Körner, for instance, who might be regarded as the most prominent representative of aromatic chemistry, used them in a very different sense from that in which they were ordinarily regarded. Moreover, there were numerous benzene compounds which at one time had been regarded as ortho, and were now considered para or meta, and the same might be said of bodies formerly regarded as para or meta. For his own part, he was in the habit of associating the various di-derivatives with the typical compounds, resorcin, pyrocatechin, and hydroquinon; for instance, those which could be converted into or were related to resorcin, he distinguished by the prefix *reso-*, and so on.

Dr. Wright thought they ought all to be thankful to Dr.

Armstrong for the trouble he had taken in collating facts relative to these two symbols. There was an objection to the use of the terms meta and ortho in connection with the benzene derivative, inasmuch as they had long ago been applied to distinguish two of the phosphoric acids, the meta-being obtained from the ortho-acid by the abstraction of water, but nothing of the kind occurred in the case of the benzene compounds. He quite agreed with the speaker that these symbols should not be taken to represent any relative position of the atoms in benzene.

Dr. Odling said he might perhaps be permitted to remark that the term meta was first used by Graham to indicate that meta-phosphoric acid still contained water, phosphoric anhydride being at that time regarded as the true acid; and he had advocated the view that those acids which had the full amount of base or basic water should receive the prefix ortho.

Mr. Kingzett made some remarks on the benzene ring. He agreed with the view advocated by Dr. Armstrong that the six carbon stones were united so as to form a closed chain. This afforded a means of explaining the different behavior of phenose,  $\text{C}_6\text{H}_4(\text{OH})_2$ , from that of the sugars, of which there were many having the same empirical formula  $\text{C}_6\text{H}_{12}\text{O}_6$ . He had found that in certain reactions acetic acid could be substituted for sugar, and it was worthy of notice that if the formula of acetic acid,  $\text{C}_2\text{H}_4\text{O}_2$ , be tripled it is the same as that of sugar,  $\text{C}_6\text{H}_{12}\text{O}_6$ .

Dr. Armstrong, in reply to a question put by Dr. Odling as to the difference in solubility in alcohol between ordinary potassic benzoate and that recently prepared by the action of alcoholic potash on benzoic aldehyd, first observed by Gregory, said that he did not know of any explanation of the fact. He also cautioned Mr. Kingzett against hastily drawing conclusions from the supposed constitution of phenose, as it was not by any means satisfactorily established that it had the formula assigned to it by Carius.

The next paper was by Mr. W. H. Perkin, "On the Formation of Coumain, and of Cinnamic, and of other Analogous Acids from the Aromatic Aldehyds."

#### A NEW AND ACCURATE METHOD FOR DETERMINING BOILING POINTS WITH SMALL QUANTITIES OF LIQUID.

By P. T. MAIN.

By the boiling point of a substance is meant the temperature at which the tension of its vapor is equal to the atmospheric pressure at the level of the liquid; the boiling point of a given substance is thus a variable temperature, depending on the varying atmospheric pressure. In defining bodies by their physical characters it is usual to state these characters, when possible, with reference to standard conditions of pressure and temperature; thus a body is defined by its specific gravity and specific heat at a standard temperature, and by its boiling point at a standard pressure. From this point of view we may define the boiling point of a liquid as the temperature at which the tension of its vapor is equivalent to a pressure of 760 m.m. of mercury at  $0^\circ\text{C}$ . The problem of determining the boiling point of a liquid resolves itself therefore into two problems: (1) To make the tension of its vapor = 760 m.m.; (2) to determine the temperature at which it has this tension. Of these problems I have attempted a solution by a method which is, so far as I am aware, new, and which is susceptible—with an accurate barometer and a sufficiently delicate thermometer—of great accuracy with quite small quantities of liquid. My apparatus for this purpose consists of two principal parts—a boiling-tube and a pressure-tube. The boiling-tube is a thin, narrow, glass tube, V-shaped, hermetically sealed at its short end, and open at the long end; the short end may be about 2 inches in length, the long end about 18 inches; these dimensions I have found convenient in practice. The pressure-tube is a vertical glass tube, which can be connected with the open limb of the boiling-tube by a drying-tube, and which dips into water contained in a wider glass tube; by raising or lowering this wider tube the pressure within the open limb of the boiling-tube may be made greater or less than the atmospheric pressure. The boiling-tube is held so that the bend of it is its lowest point; in this position the liquid to be operated on is distilled or poured into it in such quantity that on inclining the tube the air in the closed limb may be displaced by the liquid, which may be made to occupy the whole of this limb and a small portion of the open limb. By boiling this portion of liquid in the tube sufficiently, all dissolved air or gases may in general be expelled from the liquid, the space above which in the closed limb is then occupied by the vapor of the liquid only. The boiling point of the liquid must be known or determined first approximately, which is easily done by a preliminary experiment; and we can then determine it accurately (if it is less than that of water) by immersing the boiling tube in water at a temperature a little higher than the boiling point of the liquid, connecting it with the pressure-tube, and increasing or diminishing the pressure by means of this so as to make it exactly equal to that of 760 m.m. of mercury at  $0^\circ\text{C}$ . By carefully lowering the temperature of the water till the liquid in the boiling-tube stands at exactly the same level in both limbs, and taking a few observations of the temperature while the liquid is steady in the boiling-tube or oscillating slowly about this mean position, it is possible to determine the boiling point at 760 m.m., with considerable accuracy, with so little as 1 c.c. of liquid.

For liquids whose boiling points are higher than that of water the process would necessitate the use of dense aqueous solutions, or of some other liquid which can be heated to higher temperatures than water without boiling or decomposing.

At present I have applied this method only to liquids whose boiling points are lower than that of water.

I append the results of experiments on the following liquids: Ether, chloroform, alcohol, tetrachloride of carbon, all of which were nearly pure to start with.

Ether.—Purified from water and alcohol by sodium till effervescence ceased; boiling point,  $34.8^\circ$ .

Chloroform.—Purified from traces of water and alcohol by boiling with sodium till all action had ceased; boiling points,  $61.1^\circ$  to  $61.2^\circ$ . These boiling points were given by two portions, about 1 c.c. each, taken respectively from near the beginning and near the end of the distillate from 80 c.c. of chloroform purified by sodium. On two previous occasions portions of about 12 c.c. were taken and purified with sodium, and the boiling point of the first distillate—about 2 c.c.—from each was found to be  $61.15^\circ$ . On another occasion the boiling point of a portion of the undistilled and unpurified chloroform was found to be  $61.3^\circ$ ; and again, 100 c.c. of the chloroform, before purification by sodium, were distilled, and portions—about 2

c.c. each—from the first, middle, and last portions of the distillate, gave respectively 61.1°, 61.2°, 61.5°, as the boiling points.

Alcohol (absolute) gave boiling point 78.05°; after purification from traces of water by sodium, boiling point 78°; again, a portion—about 180 c.c.—purified by quicklime gave as the boiling points of portions from the beginning, middle, and end of the distillate, 78.1° in each case.

Tetrachloride of Carbon, unpurified and undistilled, gave boiling point 76.3°; a first portion—about 3 c.c.—distilled from about 110 c.c. gave boiling point 76.25°; a last portion from the same gave boiling point 76.3°; again, about 15 c.c. were purified from traces of water and alcohol by boiling with sodium, and distilled; about 4 c.c. were taken of the first distillate, and gave boiling point 76.5°; about the same quantity at the very end of the distillation gave boiling point 76.6°.

While I was uncertain about the reading of the thermometer—as, e. g., whether it was 76.2 or 76.3—I put it down as 76.25; but my thermometer was not divided so widely as to give exact readings to within less than 0.1° C.

The above determinations are, I believe, nearly exact, but my object in giving them is not to put them forward as accurate results, but as indicating, by the closeness with which they agree with each other for the same nearly pure liquid, the degree of accuracy which may be expected from the method when it is more matured.

At the present I have sufficient confidence in my results to say that the boiling points are not in error by so much as three tenths of a degree centigrade; and that, if there is an error of more than one tenth of a degree, it is due, not to any imperfection of the method, but to inaccuracy in the reading of the thermometer or of the barometer.

I hope before long to make some fresh determinations with more delicate thermometers.

The usual method for determining boiling points is incapable of giving accurate results, for this reason—that it is impossible to secure that the vapor tension of the liquid at the temperature observed differs from the atmospheric pressure at the level of the liquid by an inappreciable amount only. By my method it is quite possible, and not very difficult, to secure the fulfillment of this all-important condition.

St. John's College, Cambridge, January, 1877.

—*Chemical News.*

#### ON INDIGO STEAM BLUES.

By M. CH. ZURCHER.

A color fulfilling all the necessary conditions of such a blue should contain, along with the thickening of the indigo, a reducing agent, and a substance neutral in the cold, but capable of becoming alkaline at the temperature of steaming. M. E. Schlumberger has proposed for this purpose the use of the cyanide of potassium; but this substance, besides its high price, is a powerful poison. The author finds that the bicarbonate of soda, whose alkalinity becomes strongly marked at a temperature of 153° F. to 176° F., furnishes, then, a neutral carbonate capable of dissolving white indigo.

A color formed of 35 fluid oz. of neutral gum water, 8½ oz. tin pulp, 3½ oz. bicarbonate of soda, and 10½ oz. of ground indigo pulp at 30 per cent., is not reduced in the cold, but, if heated, reduction sets in, and the white indigo is dissolved. If printed on to the cloth, the reduction of the color only sets in if the steam is very moist; therefore, it does not succeed in the ordinary steam-chests, but in steam-chlorine chests. The printed swatches come out from these chests with the greenish-yellow color of the solution of white indigo.

The problem of indigo steam blues will not be completely solved till a perfect arrangement for moist steaming has been discovered.—*Bulletin de la Soc. Indust. de Mulhouse.*

#### WOOLLEN PRINTING.

##### GREEN, FOR WOOLLEN CLOTH OR YARN.

Berry extract..... 17½ ozs.  
Extract of indigo..... 17½ "  
Oxalic acid..... 14½ "  
Alum..... 17½ "  
Calcined starch..... 17½ "  
Print, steam for an hour, and wash.

##### STEAM GREEN FOR DELAINES.

Aldehyd green prepared for printing... 35 fluid ozs.  
Gum water..... 350 to 700 "  
Add 2½ oz. of tannin, per 35 ozs. of mixed color. Steam for three-quarters of an hour, and wash.

##### BLACK FOR WOOL.

Extract of dry logwood..... 5½ lbs.  
Dissolve and let settle, and add to the clear liquor the decoction of 16½ ozs. of galls, thickened with the same weight of gum tragacanth; let cool, strain, and add 3 lbs. 4½ ozs. pyrolignite of iron, at 15° B.; 2 lbs. 3 ozs. nitrate of iron, at 5° B. Print and steam for an hour.

##### GREEN FOR WOOL.

Dissolve 1½ ozs. oxalic acid in 17½ fluid ozs. of water, and add to this solution, whilst hot, 6½ ozs. of fustic lake, precipitated from a decoction of fustic with bichloride of tin. On the other hand, dissolve ½ oz. of extract of indigo, and 3½ ozs. of alum, in 17½ ozs. of water.  
Mix the two solutions, and thicken with dextrine or gum Senegal.

Print, dry, and steam.

##### SCARLET FOR WOOLLEN PIECES OR YARNS.

Cochineal liquor at 70° B..... 5½ pints.  
White starch..... 2¼ ozs.  
Boil well, and add—  
Oxalic acid..... 1½ oz.  
Stir till cold, and add, stirring continually—  
Fin crystals..... 1½ oz.  
Berry liquor at 7° B..... 3½ "  
Mix well, print, steam for an hour, and rinse.

##### AMARANTH FOR WOOLLEN PIECES OR YARNS.

Dissolve 12 ozs. orchil, and make up the solution to 1½ pint. Extract 4½ ozs. cochineal, and make up the decoction to 36 fluid ounces. Mix and thicken with 8½ ozs. white starch.

Stir till cold, and add 3½ ozs. of alum in powder, and 1½ oz. bichloride of tin, stirring all the time.

Mix well, print, steam, and wash. The following colors may be employed either for machine or block work, and are distinguished for simplicity:

##### BLACK.

Dissolve 6½ lbs. dry extract of logwood in 10½ pints of boiling water; let cool and settle. Add to the clear liquid

17½ ozs. of black liquor at 5° B., and 4½ ozs. nitrate of iron at 50° B. Thicken with 8½ ozs. gum tragacanth. This latter weight must be varied according to the quality of the gum and the nature of the design. Print, air for 6 hours, steam for ½ hour at 213° F. Steam immediately.

##### BROWN.

Dissolve 2 lbs. 8 ozs. extract of redwood and 17½ ext. act of quercitron in 10½ pints of boiling water. Cool and settle, thicken the clear liquid with 4½ ozs. of gum tragacanth, and add 8½ ozs. red liquor at 5° B. The color may be used directly. For a deeper brown, add black liquor as may be needed. Print, air, steam, and wash.

##### BISMARCK BROWN.

In 10½ pints of boiling water dissolve 1 oz. of Bismarck brown, more or less, according to shade. Let settle and cool; thicken with 2½ ozs. gum tragacanth, the same weight of white starch, and ½ oz. of good glue. Print, air for 6 hours, steam at 194° F., and rinse.—*Le Teinturier Pratique.*

#### POISONOUS POTTERY.

THE study of *faience* has its sanitary as well as its artistic side. An interesting report on the former branch has lately been made by the Parisian authorities.

It was necessary to ascertain, firstly, whether lead or copper entered into the composition of the glazing; and, secondly, whether the oxide of lead was vitrified on the surface, as a silicate, or whether it was simply melted. After visiting a great number of factories, M. Drouard was able to ascertain that the brown color in hardware was obtained by a mixture of peroxide of manganese, and the green by the introduction of a slight quantity of oxide of copper, improperly termed "calamine," while minium and sulphide of lead produce the yellow glazing. There are, therefore, two deadly substances in use—the minium and the oxide of copper. If the temperature of the oven were sufficiently elevated, the oxide of lead would be converted into silicate of lead, and be able to resist the action of at least weak acids. But to insure the success of this combination, it is necessary to consume a large quantity of fuel, and in Paris this operation is particularly expensive. The manufacturers consequently seek to reduce their outlay, either by augmenting the quantity of oxide of lead, or by burning less fuel. In this case the minium spread over vessels placed in the upper part of the oven is simply fused with the clay, and is easily dissolved by the most feeble acid. Various experiments were made in all the arrondissements of Paris, which conclusively proved that acid liquids, such as sour milk and also grease, often dissolved the oxide of lead contained in the hardware used for domestic purposes. The reporters consequently resolved that the strictest supervision should be kept over the manufacture of hardware for domestic purposes; that the manufacturer should be compelled to affix his mark to each article, so that it might be traced back to him whenever the glazing was found to have been improperly effected.

#### CHRYSPHONIC ACID.

THE celebrated "Goa powder," used for ringworm, etc., has been found by Mr. Squire to consist largely of chrysophanic acid, a substance also obtained from rhubarb, dock-root, etc.

Mr. Squire finds that the properties of chrysophanic acid are by no means confined to its being a remedy for ringworm, but that it is likely to prove a valuable addition to the list of drugs as a remedy in many other diseases of the skin. He has, for example, obtained some unquestionably good results with it in the treatment of psoriasis, and it is a serviceable application in cases of lupus also.

#### THE NEW STAR IN CYGNUS.

ON November 24 Dr. Schmidt remarked a new star of the third magnitude in the constellation Cygnus, which must have blazed out very suddenly, for it was not noticed when he last had an opportunity of observing on November 20 nor on any previous night, and could, therefore, hardly have been as bright as the fifth magnitude. The star very rapidly waned, falling to the fourth magnitude on November 28, to the fifth on November 30, to the sixth on December 6, and to the seventh on December 15, after which date it has but very slowly diminished. The position of the star is R.A. 21h. 30m. 50s., N.P.D. 47° 43'; and no record of any star in this place can be found in the Bonn Durchmusterung, which gives all stars down to the ninth magnitude inclusive, or in any other catalogue. Thus, till its sudden blazing forth last November, it has presumably been of extreme faintness, like the new star of 1866, *T Coronae*, and others before. Immediately after the discovery, Dr. Schmidt at once telegraphed to Prof. Littrow at Vienna, and also wrote to M. Le Verrier at Paris, where a spectroscopic examination of the star was made by M. Cornu on December 2 and 5, though the star had then fallen to the fifth magnitude and the weather was very unfavorable. M. Cornu found the spectrum to consist of bright lines on a faint continuous spectrum almost completely interrupted between the green and blue. The bright lines appear to correspond to hydrogen, sodium or helium, magnesium, and the coronal substance, which gives the line 1474K in the green. These are in fact the principal elements in the sun's chromosphere, so that the new star has presumably an atmosphere similar in its constitution to that of the sun, and it is this atmosphere which has suddenly blazed forth, the underlying photosphere giving comparatively little light, and thus presenting the exact converse of what occurs in the case of the sun, where the photosphere is so bright as completely to extinguish the light of the chromosphere. It is much to be regretted that no news of the discovery of this new star was sent to this country till December 9, when the published account of the Paris observations arrived. Unfortunately, cloudy weather on the Continent prevented observation at the critical period immediately after the discovery, while, if Prof. Littrow had telegraphed to England, observations might have been made on no less than eight nights preceding December 9. The omission is the more strange since the telegraph companies concerned have with great liberality made a convention, by virtue of which telegrams announcing astronomical discoveries are transmitted free of charge; and this concession is regularly taken advantage of to announce the uninteresting additions which are continually being made to the already too numerous swarm of minor planets. In the case of this star an opportunity, which can hardly be expected to recur soon, has been lost of determining the changes of the relative brightness of the various lines and in their breadth; from which most interesting results as to the temperature and pressure of the vapors in the star's atmosphere might perhaps have followed. The changes in the spectrum of hydrogen, as depending on

temperature and pressure, are in particular very remarkable, and a comparison of the three lines of this gas in the new star at different dates might have given most valuable information on this point. Even as it is, M. Cornu has, under very unfavorable circumstances, obtained most important results.

#### THE POSITION OF THE EQUINOX.

THERE has always been a difficulty in fixing the exact position of the point from which right ascensions are reckoned, as it can only be done by observations of the sun, from which the place of passage through the equinox is deduced. Such observations are liable to be affected by all sorts of errors, some of them depending on temperature, which may alter the state of the instrument and the rate of the clock in the interval from day to night and from summer to winter; while others arise from peculiarities in the observer, especially in the habit of observing the first and second limbs of the sun; and others, again, depend on the instrument, whether arising from errors of graduation of the circle or deviation from circularity in the pivots. These latter errors will affect the times of transit of stars and thus make it difficult to obtain a standard catalogue of the right ascensions of fundamental stars. It has naturally been the aim of astronomers to eliminate these various sources of error, and they have so far succeeded as to reduce the outstanding discrepancies between different sets of observations to a few hundredths of a second; but even these quantities are larger than would be expected if the thousands of observations employed were only free from systematic error. M. Nyren has lately discussed the observations of the sun made at Pulkowa from 1861 to 1870 and has been met with the same difficulties which have puzzled former astronomers, there being a considerable discordance between the declinations obtained by the two observers concerned. M. Nyren's result differs considerably from the mean of those found at other observatories, and in particular by 0.064 from the place of the equinox determined by Greenwich observations from 1836 to 1870, and by 0.055 from that given by former observations at Pulkowa. Though the places of the fundamental stars may require some slight corrections, they can hardly affect the result by more than a few thousandths of a second, and will therefore not account for the above discrepancies, which M. Nyren considers must arise from some unknown systematic errors. It is to be remarked that all the determinations of right ascension at Pulkowa have been made by one observer; while another, using a different instrument, has been charged with the observations of declination, and any personality in the habit of observing would affect the two co-ordinates differently. Such personality is commonly different for the two limbs, and consequently affects the place of the sun's center, so that, as M. Le Verrier has pointed out, it is in the present state of astronomy far more important to multiply observers than observations.—*Academy.*

#### FRENCH ACADEMY OF SCIENCES.

JANUARY—FEBRUARY.

On the Flow of Mercury in Capillary Tubes, by M. Villari. Conclusions: The quantity of mercury which flows in one second is 1°, proportional to the pressure under which the flow occurs; 3°, proportional to the fourth power of the radius of the tubes; 3°, inversely proportional to the length of the tubes, provided a certain minimum length, which is smaller as the tubes are less in diameter and the pressure lower, is not exceeded. For tubes of elliptical section, the minimum length, below which the preceding laws are not verified, is smaller than for circular tubes, the radius of which is equal to the average radius of the tubes of elliptical section. The above laws do not hold true when the flow occurs drop by drop. Finally, the quantity of mercury that escapes depends upon a certain constant, which must be determined for each kind of tube employed. This constant depends on the form of the opening of the tube and on the nature of its sides.

On an Experiment Analogous to that of the Singing Flames, by M. Montecat. A piece of burning charcoal, held in a little cup of wire gauze, is lowered in a long metallic tube placed vertically when the charcoal reaches the lower part of the tube, the current of air produced by the elevation of temperature causes a sound which increases in loudness as the combustion becomes more active. If the coal be gradually raised, the sound at first becomes more intense, then diminishes, and ceases on the middle of the tube being reached. If the upward movement be continued, the sound again is heard, but the note sounded is the double octave of the first. When the orifice of the tube is reached, the sound stops. By altering the length of the tube, the author obtains analogous results.

On a Graphic Study of Brain Motion, by M. Giacomini and Morso. A woman who had lost a large portion of the frontal bone and the two parietal bones was the subject of investigation. Over the portions of the skull thus deprived of bone, a Marey exploring drum was adjusted, which by a rubber tube was brought into communication with a drum governing a lever and pencil which left a trace. The traces obtained, even when the respiration was normal and not very deep, presented evident oscillations, and formed a zigzag ribbon with unequal sides, as the height of each pulsation diminished during inspiration and augmented during expiration. The more energetic pulsations of the heart produced almost always an augmentation of the pulsations of the brain. It was only after compression of the carotids or of the jugular veins that a diminution of volume of the brain, agreeing with a considerable augmentation of the height of each pulsation, was noticeable. During deep sleep, with snoring, there was a marked increase to the height of each pulsation. By compressing the jugular veins, an augmentation of the volume of the brain was produced. After twenty or thirty seconds of venous congestion of the brain, the volume of the organ began to diminish. During venous congestion, the pulsations increased considerably in height, and this increase continued for quite a long time, even after the re-establishment of normal venous circulation. After venous congestion there was always observed a diminution in the volume of the brain, produced probably by a contraction of the blood vessels. Very extended inspiratory movements exercised a profound influence on the form of the cerebral pulsations, and it was noted that the phenomena produced were the same as those shown on compressing the carotids. Every movement of the body and all intellectual work reflected themselves on the brain, which underwent a visible modification in volume and in the form of its pulsations.

On the Coagulation of Fibrine, by M. Schmidt. The coagulation of fibrine essentially consists in a process of fermentation. Albumenoid substances, formerly soluble, are converted under the action of a specific ferment and in pres-

ence of a small quantity of neutral salts of alkaline metals into insoluble bodies. Both substances are the substratum of the fermentation. With regard to the ferment, it does not pre-exist; it is formed when liquids spontaneously coagulable are removed from their natural conditions of existence. The places of formation of the ferment are the white blood corpuscles, those of the lymph, the chyle, of pus, and perhaps those also of the general connective tissue. In a word, the cellulose contain protoplasm.

In a later note on this same subject, the author says that, when the substance which he terms the "ferment" is obtained in a state of sufficient purity, it may be caused to act upon liquids containing the generating substances of the coagulation. Thus, when it is desired to exhibit the part which the fibrino-plastic substance takes in the coagulation, serosities are employed, containing only the fibrinogenous substance. Both kinds of liquids are met with, and the author calls the first proto-plastic liquids, to distinguish them from the liquids which coagulate spontaneously, which contain the ferment as well as the generators of the fibrin, and which are known as plastic liquids; the second, fibrinogenous liquids. In order to obtain pure ferment, the following process may be used: sanguineous serum is coagulated with 15 or 20 times its volume of concentrated alcohol. This is not filtered until after about four weeks (in order to render the albumenoid substances as insoluble as possible), when the clot which contains the ferment is dried at the ordinary temperature. The clot should be pulverized, digested in water, and filtered. The filtered liquid contains ferment, traces of salts, and a small quantity of non-modified fibrino-plastic substance. This last alcohol completely precipitates, but concretes it only in part. When the clot is extracted with water, the non-concreted substance is dissolved, and passes through the filter.

#### THE SEWAGE QUESTION.

At the ninth ordinary meeting of the present session of the Institution of Civil Engineers, lately held in London, Mr. George Robert Stephenson, President, in the chair, a paper was read on "The Sewage Question" by Mr. C. Norman Bazalgette.

The object of this communication was stated to be twofold. First, to limit and define the proper application of the various systems introduced from time to time for dealing with the sewage of towns. Secondly, to direct attention to certain subordinate questions arising upon the practical operation of such systems. For the purposes of this paper, the following classification had been adopted: 1. Treatment with chemicals; 2. Application of sewage to land, including irrigation and intermittent downward filtration; 3. The dry-earth system; 4. The Liernur or pneumatic system; and 5. Seaboard and tidal outfalls.

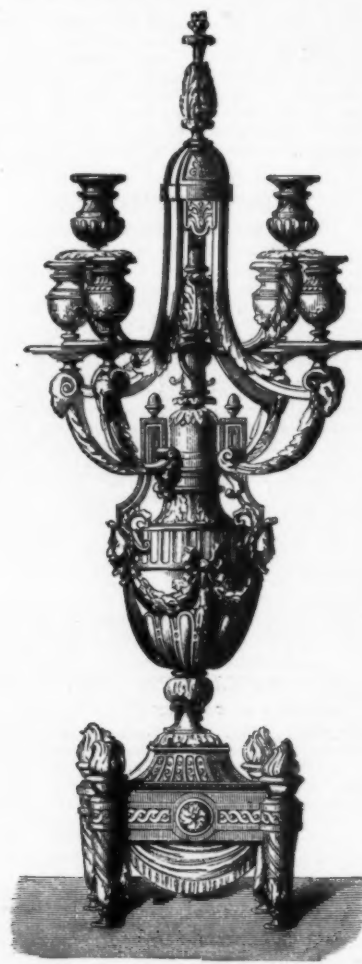
##### 1. Treatment with Chemicals.

In this section of the paper, reference was made in considerable detail to the practical experience of the line process at Leicester, Tottenham, Blackburn, and Birmingham; the A B C process at Leicester, Leamington, Crossness, Hastings, Southampton, Bolton, and Leeds; the sulphate of alumina process at Coventry; the phosphate of alumina process at Tottenham, Barking, and Hertford; Goodall's process at Leeds; Bird's process at Cheltenham and Stroud; Dugald Campbell's process at Battersea; and Whitbread's process at Tottenham. It was stated, generally, that the experience of these processes was more or less identical with that which had been derived from Holden's, Hill's, Lenks', Suvern's, Scott's, and, in fact, all other methods in which, by the admixture of chemicals, it was sought to effect the purification

that the proportions which they had affirmed population might bear to acreage, ranging in the case of 1 acre drained 6 ft. deep from 2,000 to 3,300 persons to the acre, were too high, and were not justified by the experiments. The practice of downward filtration at Merthyr was next referred to, and it was shown that the extent of its practical operation there had been exaggerated, and that the results confuted instead of confirmed the proportions of the Rivers Pollution Commissioners. The experience of Walton and of Kendal was also reviewed, and the following general conclusion completed this section of the paper: That where land could be acquired at a reasonable rate, irrigation was the best and most satisfactory known system for the disposal of sewage, but that intermittent downward filtration might be practised where the necessary surface area for broad irrigation could not be obtained. Experience, however, showed that the permanent proportion of population to acreage, where land was drained 6 ft. deep, should in no case exceed 500 or 600 persons to an acre.

##### 3. The Dry-Earth System.

The applicability of this system to towns was next considered, and it was shown that it must be supplementary to, and not substitutive of, a water-carriage system, thus enormously increasing the cost of making sanitary provision for towns. The effect of its introduction into the metropolis, as a test case, was illustrated by figures, to prove that it would be superfluous, costly, cumbrous, and impracticable. Indeed, its applicability became diminished in the inverse ratio to the increase of population, to which it was proposed to apply it; and though it might be occasionally used with advantage in hamlets or detached buildings and institutions, it was unsuitable for the wants of towns.



VASE CLOCK AND CANDELABRUM. STYLE OF LOUIS XIV. DESIGN OF M. J. LEFEVRE, PARIS.

(From the Workshop).

This impurity is avoided by producing a precipitate by means of carbonic acid, filtering the liquor through a paper filter folded three or four times, and treating with carbonic acid in excess. When the alcohol is allowed to act on the clot for several months, the quantity of fibrino-plastic substance which passes into the aqueous extract is so small that it may be disregarded. Now, if a proto-plastic liquid be mingled with any quantity whatever of this ferment or solution, coagulation ensues, either in a few minutes or a few hours, according to the amount of ferment used. The neutral salts of alkaline metals are necessary that the concretion of the fibrine may take place.

On the Action of Chlorochromic Acid on Organic Matters, by M. Etard. Toluene is strongly attacked. Hydride of hexyl, coming from petroleum, treated in the same manner as toluene, gives birth to a small quantity of an acid which has been extracted from salts of chromium soluble in water. Crystallizable acetic acid, submitted to chlorochromic acid in a closed vessel, in proportion of 150 parts of the first to 50 of the second, yields a salt dark green by reflection, crystallizing easily, and containing chromium in two forms—acid and basic.

On a New Derivative from Albumenoid Matters, by M. Schutzenberger. In an operation in which 23 lbs. of albumen were decomposed with baryta hydrate, the author isolated a few ounces of a new amidized body. It is flat white in color, chalky in appearance, and crystallizes always in balls. The formula obtained is  $C_7H_7NO_4$ .

On the Crystallization of Gallium. By M. Lecoq de Boisbaudran.—Metallic gallium, crystallizes under the form of octahedrons truncated very clearly at the base. The faces are not sufficiently plane to permit of exact measurements, but the values thus far found, for the angles seem to point to a rhombohedral form.

of sewage by the precipitation of the dissolved and suspended impurities, and the ultimate realization of the precipitate in the form of a manure. This experience, coupled with certain opinions of Professor Frankland, Mr. Krepp, and Dr. Corfield, which were cited, was relied upon as establishing the following conclusions: That no chemical process could efficiently deal single-handed with sewage, but must be assisted by subsequent natural or artificial filtration of the treated sewage, and therefore no chemical process *per se* should be adopted for the purification of town sewage. The principal objections to chemical processes, which appeared upon the experience of the places where they had been adopted, and upon which this conclusion was founded, were, inefficiency of treatment, cost of treatment, and difficulty of manipulating the accumulations of sewage sludge.

##### 2. Application of Sewage to Land.

The author first considered whether sewage could be made to yield an agricultural profit. The Parliamentary return of 1873 was referred to, and the financial position of the Warwick farm was specifically examined. The question was also raised, whether sewage possessed any fertilizing value beyond ordinary water for the purposes of irrigation, and the experience of the Barking farm having been appealed to upon this point, the conclusion was laid down that no profit ought to be expected from the cultivation of crops by sewage irrigation. The next point discussed was whether any definite standard could be laid down as to the proportion population should bear to acreage in the practice of irrigation, the proportions exhibited by eleven towns being referred to, and it was determined that it was impossible to frame a specific rule. The theory of intermittent downward filtration was then investigated, as based upon laboratory experiments of Rivers Pollution Commissioners; and it was argued

##### 4. The Liernur or Pneumatic System.

A description of the mechanical characteristics of this system was first given, and then the experience yielded by its operation at Leyden, Amsterdam, and Dordrecht was specifically analyzed. It was supplementary to, and not substitutive of, a water-carriage system, extremely costly, and its mechanism was complicated and liable to get out of order. The accumulation of sewage residuum in the central reservoir, and its subsequent decanting into barrels, were operations which could not fail to be objectionable and offensive. Its appliances were therefore not suitable for a high-class community, and no return from the manufacture of "poudrette" could be expected. In conclusion, it was urged that the system was of such a character that, though it might have a partial province in the tide-locked cities of the Hague, where no system of sewerage was available, it should never be imported into an English town.

##### 5. Seaboard and Tidal Outfalls.

The first point considered was the return of the sewage of seaboard towns upon the beach; and it was maintained that where care had been taken to determine by float observations to the force and set of the currents to which the sewage was to be committed, there was no difficulty in preventing such a result. The sea constituted the most natural and economical outfall for the sewage of towns situated upon it, and such means of outfall should be adopted. With regard to sewage outfalls upon the tidal portions and estuaries of rivers, there ought to be, arguing from the experience of the metropolitan outfalls, and assuming that proper precautions were taken in the selection of the outfall, and the exclusion of silt from the sewers, no danger of the silting up of the navigable channel.

